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TO PSYCHOLOGY

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GENERAL INTRODUCTION TO PSYCHOLOGY

A SURVEY OF THE PROGRAMS OF PSYCHOLOGY

BY

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PREFACE

The original aims of this book were (i) to give second semester students a broad perspective over that whole field of research which they have come, in their first semester, to know in terms of its fundamentals, and (ii) to give students who can devote only a single semester to psychology, a reasonable orientation in the field at large. Both of these aims of the original edition have found, so the author hopes, a further expression in this revision.

Part One has been entirely rewritten. As a matter of fact, because of the complete change which has been introduced into this part, the book may now commend itself to maturer students as an introductory text in psychology which can be followed by the sterner texts on the fundamentals of psychology. Everywhere the attempt has been made to let the reader surprise the psychologist at his work so that he can see (in our verbal pictures) just what the student of mental life, in times past, has meant to do, and what he now means to do.

Chapter I hazards a picture of psychology, the outlines of which are suggested by the influence which biology has been exerting on psychology ever since the turn of the century. Then, in Chapter II, comes an introduction to psychology and a perspective over the whole field by way of the history of psychology. This is not a formal history but an attempt to ask once more some of the first questions that were asked, and an attempt to answer these questions as the founders of psychology answered them. Stress is laid upon problems, upon points of view, and upon tendencies in research and in thinking rather than upon discoveries, or upon dates and events. Chapter II leads on naturally to Chapter III which undertakes a survey of the various schools of psychology. These schools are considered not as "systems of psychology," but as a way of stressing the persistent problems and aspects of what, in the long run, must become a unified science. The fourth chapter takes up a question emphasized both by the modern biological psychologies and by the "explanations" familiar to the older "physiological psychologies," viz., the question as to what are the talents of nervous systems.

Part Two has been greatly changed and modified in order to bring it in line with the programs suggested in Part One. The whole section has been brought up to date and amplified by many pages of new material. The rest of the book has undergone less revision; but everywhere, new material has been added and obscure passages clarified. It is hoped that the new material throughout the revision will add a few lines and high lights to what, at the very best, must remain a sketch.

This book, like its predecessor, is in no sense of the word, a systematic formulation of the field of psychology. Its more modest ambition is to help students become acquainted with the science in the large and to understand its shifting successes and failures.

The author wishes to express his indebtedness to the generous critics of the first edition, to the Macmillan Company for the kindly way in which they have handled the problems incident to revision, to those who have aided in the manuscript and in the arduous task of reading the proofs, and to those of his teachers who have whetted his appetite for things experimental and psychological. Finally, the author will always be grateful to the Trustees of the Guggenheim Foundation who, in the form of a Fellowship, gave him the opportunity to make extended studies upon some of the problems and points of view expressed in the early part of the book.

Coleman R. Griffith

Champaign-Urbana
February, 1928

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PART ONE

THE FOUNDATIONS OF PSYCHOLOGY

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CHAPTER I

PSYCHOLOGY AS A BIOLOGICAL SCIENCE

Introduction.—The experimental study of those events which are commonly known as psychological is about three generations old,—as measured by the lifetime of a man; but in spite of this respectable maturity no two experimenters are fully agreed as to what the problems, the methods, and the subject matter of the science really are. It is said that present-day psychology is facing in the right direction; that it is not facing in the right direction; that its methods are adequate to its point of view; that its methods are not adequate to its point of view; that its subject matter should be conscious states or processes, or mind, or conscious experience; that its subject matter should be reflexes, responses to stimuli, reactions, movement systems, behavior; that its nearest relative is physiology; that its nearest relative is logic; that it should be affiliated with biology; that it should not be affiliated with biology; that it treats of a unique order of events which stand in sharp contrast to the physical order; that there is only one such order, viz., the natural or material order; that it should start from the mental life of the adult human being; that it should begin its work with the lower animals; that at any rate it is a science; that at any rate it is not a science and never should become a science.

Fortunately, these differences of opinion have not deterred experimenters from making astonishing progress in the discovery of facts which are, in one respect or another, psychological. We shall crowd as many of them as possible within the chapters which follow, but this is not our main task. We seek, on the contrary, to surprise psychologists at their work rather than to record what they have done. We mean, that is, to get acquainted with the kind of questions which the psychologist asks about life and about intelligence; we mean to see where he has gone and where he now goes for his materials; we propose to learn how he uses some of his methods and pieces of apparatus, and how he gets into and out of quarrels with his fellows and with men of science in other fields.

Despair, of course, is a word that does not belong to the working vocabulary of a man of science, and between the hours spent in the laboratory the psychologist frequently pauses with the hope that new horizons are showing under the light of new facts. In recent years, increasing hope has been placed upon psychology as a biological science. Behaviorism, animal psychology, studies in the behavior of children and studies of behavior in general, have been mightily suggestive of what psychology may expect in this direction. It shall be our first task, accordingly, to consider the program of a biological psychology.[1]

Definition of Science.—Science is a way of asking questions and a way of finding relevant answers to them. The best questions are always as precise and as simple as the situation or the nature of the object or event will permit, and the answers are sought wherever possible under known and controlled, that is, under experimental conditions. We begin science with two general assumptions, viz., (*a*) that there is a natural world of objects, events, and processes about which questions may be asked, and (*b*) that every normal person, being a natural member of this natural world, has the capacity or the talent and the habit of asking appropriate questions and of setting up appropriate conditions for the getting of an answer to his questions. When men earned this capacity or talent, of what it consists, and how they came by the habit is a problem in genetic psychology and will concern us in Part Two. Whole volumes of philosophy are involved, of course, in the assumptions with which science begins; but we must lay them all aside for the sake of hearing what science has to say for itself, once it has begun to collect its facts.

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[1] The reader will not see all that this chapter means unless he has a clear picture of what modern science has to say about the nature of man and his relations to the natural world which is his home. It is recommended, therefore, that he read Newman, H. H., and others, *The Nature of the World and of Man*, 1927.

The natural world of objects, processes, and events to which we address our questions appears, on first inspection, to fall into two parts. The one part is made up of objects and events which we may call non-living or inorganic, and the other is made up of objects and events which we may call living or organic. The questions we ask about living and non-living objects and events, about the whole of creation as it comes to us in our daily experience, and the answers we find for these questions fall into several closely related groups and give rise to the several branches of science as we know them today.

The Branches of Science.—Physics appears to be one of the most fundamental of the sciences—it may be *the* fundamental science—for it asks about the ways and properties of the final or ultimate parts and processes of the world of nature, that is, about molecules, atoms, electrons, protons, or whatever else may appear in the course of constant questioning. Chemistry is a branch of science more closely related to physics than is any other, for it treats of the ways in which the ultimate constituents, events, or processes of nature come together in the formation of the larger objects and events of our daily experience.

It is within chemistry that we find appearing for the first time—so far, at least, as present research can assure us—that division between what we call the organic and the inorganic compounds, that is, between (*a*) those substances which appear to have marked the origin of and which now constitute, living organisms, and (*b*) those substances which, no matter how complex or elaborate they become, are never said to be living. In the direction of the truly inorganic compounds and masses we find such further sciences as mechanics, geology, astronomy, meteorology, and the like. We call these sciences physical sciences, for they have no other fundamental principles than those which they derive from physics and chemistry. For methodical or practical reasons they may be separated from physics, but a final analysis of the events constituting a volcano, a flash of lightning, or the motions of a star always takes us back to physics.

In the direction of the organic compounds, we find the biological sciences or the sciences of life. Psychology is to be found somewhere in this group. It remains to be seen whether the ultimate analyses of physics and chemistry can be taken as the final principles of biology. That is, we do not know as yet whether the division between organic and inorganic which appears clearly for the first time in chemistry will eventually appear also in physics, that is, in the final constituents of nature, after research has taken us a few steps farther. We cannot say whether the physical sciences and the biological sciences grow out of two types of natural world instead of one (as we have assumed) or whether *vital* facts, too, will sometime be explained by the central facts of physics. It has looked, for a great many centuries, as though living organisms owed their existence to certain unique principles not derivable from physics. We remind ourselves, for example, of such entities as vital force, psyche, mind, spirit, soul, and the like. Today men are in profound disagreement about this matter. Even though physical and chemical facts are becoming increasingly significant in understanding the ways and properties of life, it is still convenient and illuminating to set the biological sciences in partial contrast to the physical sciences.

The Problems of the Biological Sciences.—Living organisms, from the most simple to the complex, are the object of study of those sciences we call the biological sciences or the sciences of life. The biological sciences propose to give an exact account of the gross structure, the origin and growth, the processes of maintenance, and the processes of adjustment of organisms, together with their many modes of functional relationship to the environment of which they are an integral part. Psychology is a biological science, but in order to find its precise field of work we must sketch briefly the problems of the various branches of biological science.

(*a*) *Anatomy* is the study of the structure or of the type of architecture of living organisms. Gross anatomy or anatomy proper regards the form and the composition of the larger organs of the body. It finds that living organisms are a collection of machines, each built in a certain way and each ready to carry out some precise function in the economy of the whole creature. Supplementary to anatomy is *morphology*, that is, the study of the fine anatomy of living bodies, of the cells and of other simple structures of which the whole is composed. It is obvious that morphology may lead directly back to physics and chemistry, for we have no reason to suppose that the substances or events of which cells are composed differ qualitatively from the substances or events of which any material object is composed.

There are as many branches or subdivisions of anatomy as there are men who have a special interest in the whole field. There is, for example, the anatomy of the receptors, of the nervous system, of the internal organs of the body, of the organs of locomotion, the anatomy of special animal groups or families. Thus any organ or group of organs, or group of creatures can become a special object of regard to a specialist.

(*b*) *Physiology* is the study of the processes that go on within the individual organs of the body and within the organism as a whole. The various organs and structures which are described by the anatomist all have their appropriate tasks, *e.g.*, digestion, respiration, circulation, secretion of various liquids, assimilation and dissimilation, contraction, and conduction. The body is, as we have said, a collection of wonderful machines, but we think falsely if we assume that the organs and the functions are to be taken independently of one another. All of the part functions can be understood finally only when we consider the unique functional qualities of the organism as a whole. The mere fact of being alive reveals a chemical and nervous unity of function which stands in direct analogy to the structural or architectural unity of the body.

Under physiology, too, there are as many subdivisions as there are special interests. We find a physiology of the sense organs, of digestion, of the nervous system, of the glands of internal secretion, of the muscles, and so on. As we have intimated, no one knows whether or not physiology is, in the last analysis, physics and chemistry. There is, in addition to the subdivisions of physiology proper, of which we have just spoken, a biological chemistry, a physiological chemistry, and the chemistry of the nervous system, all of which support the view that life owes at least a part of its qualities to the properties of nature at large.

(*c*) *Psychology* also treats of life. It begins with the plain fact that organisms get on in an environment, that every moment of their individual lives is spent in settling accounts, one way or another, with the objects, events, and situations round about. Animals low in the scale, that is, animals simple in structure and humans low in intelligence get on with a limited number of objects in a limited number of ways. Animals higher in the biological scale and humans with greater intelligence get on with a great variety of objects and events in a great variety of ways. In addition to differences that belong to the order of "more or less" there are differences that belong to the order of "this kind, that kind." The amœba gets on with a limited number of objects, and so differs from man, who gets on, in the course of a lifetime, with an almost unlimited number of objects; but the amœba gets on in *its* way while man gets on in *his*. And between these extremes there are innumerable forms of life in which the talents of getting on may be said to look in two directions, viz., back toward amœba and into the future toward man.

The Organism in Its Environment.—The science of psychology is, of course, less than half begun when we state the fact that adjustment of some sort goes on, begun only as mechanics is begun when one says that objects move, begun only as physiology is begun when one says that the bodily organs function. "Settling accounts with an environment," "getting-on with objects and events," "making adjustments," in short, *animal behavior* has many features and aspects which lend themselves more or less readily to observation and description, and it is only after the description is done that we can read into the word "behavior" the meanings that ought to adhere to it.

Provisionally, however, we may liken the general problem of psychology to a mode of mathematical thinking. Let us assume that we have given any equation of the form $y=f(x)$, *i.e.*, y is to be taken as some suitable function of x. The value of neither y nor x is determined. That is, they are true variables, and our problem is to determine how variations in y are related to variations in x or how variations in x are related to variations in y. This is a type of problem that faces the theoretical physicist at almost every turn. If, now, we think of the organism as y and of the environment as x, and if we set up experimental conditions for the control of variations in both y and x, that is, for the control of the organism and for the control of the environment, we get a series of values of y if x is constant, of x if y is constant, and of both x and y if both are variable. Or, in the language of psychology, the behavior patterns of the organism show certain measurable values with respect to changes in the stimulus pattern, and the stimulus pattern literally changes in its value as a stimulus because of certain talents of the organism and because of changes in these talents.

Analogies cannot be pressed too far, but we have chosen this illustration from mathematics in order to escape the implication which so often comes out of physiological and biological analogies, the implication, viz., that getting on in an environment always means biological adaptation. One of the extravagances of the Darwinian theory was the notion that everything that a living creature does must have some survival value, must sooner or later have been useful in the mad rush for domination. Getting on *may* be for better or for worse, it *may* lead to survival or to death; the point is that, in a very real sense, there is a describable functional relationship between the environment as a home of stimulating agents and situations, on the one hand, and the organism as a reacting mechanism, on the other. The problem of psychology is to define this relationship in all of its parts.

Three Illustrations of Animal Behavior.—As we have said, analogies cannot be pressed too far. The surest and safest mode of finding out what adjustment or getting-on really mean, that is, the best way to illustrate the general problem of psychology, is to set before us for closer inspection several typical examples of the behavior of living creatures, say creatures at different levels of development, and therefore at different levels of talent, and discover what questions spring naturally out of the examples, what properties or traits ordinary animal getting-on seems to possess. Let us take standard descriptions from the daily life of three creatures, viz., from an amœba, from an ape, and from a human being.[1]

(*a*) *Five Minutes out of the Life of an Amœba.*—The amœba under our microscope has been lying motionless, a minute bubble of protoplasm. Shortly, for no apparent reason, small pseudopodia steal out in different directions and the whole substance of the creature slowly flows into some one of the pseudopodia. The creature thus moves. We bring a hot needle near its body; the amœba retreats. It withdraws from an incredibly small amount of calcium chloride, but approaches substances which furnish nourishment. If a pseudopodium comes within a sharply focused ray of light it is quickly withdrawn, and the creature attempts to move around the ray as if it were a solid object by sending out exploratory pseudopodia. Certain colors have no effect upon the behavior of amœba. If the amœba is very lightly touched it will send pseudopodia on two or more sides of the object and apparently attempt to swallow the object. If it is touched with moderate intensity it will retreat. The contractions of amœba, which are slow, always begin at the point stimulated and spread rapidly through the whole structure of the creature. It is not sensitive, apparently, to sound waves, and stimulating objects at a distance from its body have no effect upon the creature.[1]

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[1] We know from anatomy and physiology something of the mechanisms by means of which the getting-on of which psychology speaks is made possible. We shall consider these facts more in detail in Chapter IV. By way of preface we may note, among other pieces of equipment, receptors or sense organs which make the nervous system accessible to events external to the system, conduction fibers which carry impulses to a great central agency, the brain, other conduction fibers which relay nervous impulses from the brain (*a*) to the muscles which are the instruments of motion and (*b*) to the glands of internal secretion which are instruments for the creation and the maintenance of various types of tonicity and for regulating the bodily energies. Psychology thus allies itself in the most intimate way with physiology and anatomy, and particularly with the anatomy and physiology of the nervous system. Bare existence can be thought of independently of "getting-on," but the picture is artificial.

(*b*) *Five Minutes out of the Life of a Chimpanzee.*—Sultan (the name of one of the apes used by Köhler)[2] sees before his cage a bit of fruit. It is too distant to be reached with the hand, but there is tied to it a string which leads into the cage. Sultan grasps the string and secures the fruit. The fruit is again there but no string! There is, however, a short rod in the cage. Sultan uses the rod to push the fruit toward the cage. Now the fruit hangs from above. The animal jumps toward it without success, shortly spies a box at one side, fetches the box, climbs up and reaches the food. Once again the food hangs from above, but one box is not enough. The animal fetches another and still another, builds a tower, and thus earns his reward. A piece of fruit lies outside of the cage, there is a stick at hand, but a large box stands on the inside of the cage and just in front of the fruit. The creature moves the box aside and then with the stick reaches for the fruit. Once again fruit lies before the cage but there is no stick. Sultan makes a roll of straw which does not solve the problem; he finds a piece of wire which is too short; finally he breaks off a branch from a dead tree and thus overcomes his difficulties. On still another occasion the fruit lies outside of the cage, but the stick in the cage is too short. Outside the cage, however, and near the fruit is another and longer stick. Sultan uses the short stick to fetch the longer, and then with the longer reaches for the fruit, which he now secures. On one occasion Sultan fashions a stick long enough for his purpose by fitting two sticks together, the larger one having been provided with an appropriate hole in one end.

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[1] See Jennings, H. S., *The Behavior of the Lower Organisms*, 1906.

[2] Köhler, W., *The Mentality of Apes*, 1924.

One day, Rana, a fellow chimpanzee, finds a mirror. He repeatedly tries to move the mirror quickly enough to grasp the creature which no doubt appears to be present. The puzzle of the mirror is not finally solved.

(*c*) *Five Minutes out of the Life of a Human Being.*—The telephone rang sharply. Dr. M. took down the receiver, listened for a moment, his face becoming grave, and with a short "I'll be there immediately!" hung up the receiver, grasped his bag, opened it, took out a half dozen instruments, and put others in. These he selected carefully from a case near at hand. He chose also several bottles from a shelf in a neighboring room, grasped a few rolls of tape and some bandages, and added them to the articles in his kit. While putting on his coat he called to his wife, telling her where he might be reached in case further calls came. In a half moment he was at the garage, stopped suddenly, searched in his kit, returned to his office, selected still another surgical instrument, and a moment later was on the street. All his movements were hurried but were to be admired for their smoothness and efficiency.

The shortest road to the scene of the accident lay directly ahead, but instead of following it he turned to the right and thus found a less traveled though somewhat longer street. Only once was the even tenor of his somewhat hurried trip disturbed, viz., when a child darted out suddenly from behind a tree and stumbled into the path of his car. With a quick and smart pressure upon the brakes and a sudden turn of the wheel he avoided the danger. Within a few minutes he was at the scene of the accident. Even before he had seen the injured persons a dozen commands were out of his mouth, addressed to members of the crowd which had already gathered. One brought water, another went to a telephone, still another pushed the crowd back, a fourth brought a policeman, and a fifth took the instruments and the bandages which he selected from his kit. Without another word he began to wash wounds, bind them with tape, and do the other necessary first-aid things preparatory to a more exacting treatment at the hospital.

Defining the Problem.—We now have before us three samples of the raw stuff with which the psychologist begins his work. From this point on how does he proceed? It was formerly the custom to begin with the last sample, with the behavior of the human being (and, as we shall see, to begin as a philosopher would begin, *i.e.*, with mental life), and apply the results of his search, the principles which he discovered, to the other two samples (mentalism). Thus the human being and his mental life became the central point with respect to which other living creatures were considered. More recently it has become increasingly popular to start with principles derived from some lower creature, say an amœba or an ape, and make these principles authoritative for the human being (behaviorism). There appears to be a third and equally suggestive way, viz., to take all three samples on the same level, keep all three in view at the same time, and see what can be made out of them by way of a preface to the problems of psychology. Let us consider these three samples of animal behavior under the assumption (*a*) that each of the creatures we have observed is a natural object in a natural world, and (*b*) that we, being the observers and experimenters, have the capacity or the talent and the habit of asking appropriate questions, and of setting up appropriate conditions for the getting of an answer to our questions. We mean to describe—not, for the present, to explain. We mean to render an account of the events we have before us which will be comparable to the account which any careful observer makes of any object or event or process. This we shall do, forgetting for the moment the history of psychology and laying aside, so far as is humanly possible, certain habits of thinking which owe their origin to religion, philosophy, and opinion rather than to close observation.

The Program of Psychology.—In general, our first impulse would lead us to evaluate the three creatures we have named in terms of intelligence and to say that the amœba was the least intelligent, the man the most intelligent, and that somewhere between the two extremes stood the chimpanzee. Intelligence, however, is a tricky word, and we must, for the moment, look away from the general impression and toward the details which appear in our illustrations; that is, we must analyze intelligent behavior along lines of cleavage which nature herself seems to suggest.

The chemist has learned that he cannot deal fruitfully with earth, water, air, or fire. He deals rather with hydrogen, carbon, nitrogen, and oxygen and with fourscore and more other elements that have come out of his analytical quest. The physicist has learned to treat, not of onrushing trains and falling stars and electrically charged trolley wires, but with units of mass, of force, and of work. The physiologist and certain biologists spend their time, not with muscles and bones and nerves, but with cells and fibrils and protoplasmic tissues. The geologist fully appreciates the beauty of mountains and the botanist of flowers, but the former speaks in his laboratory mostly of mica and silicate and quartz and feldspar, while the latter speaks of stamens, pollen, and petal forms. So, too, the psychologist cannot easily understand living animals at work in their environments until he has sought out whatever partial talents the whole may offer upon close inspection. But before we consider these talents we must make two or three comments about the psychological vocabulary.

The Current Terminology of Psychology.—Psychology became a science before biology did, that is, before biology had discovered those concepts and those properties of living beings that were distinctively biological in meaning rather than physical and physiological. This was an unfortunate fact for psychology. The founders of modern experimental psychology had at their disposal a large number of concepts and words which they had inherited from theology and from philosophy, and upon these concepts and words they placed the experimental methods and the concepts of late nineteenth-century science, a science that was through and through physical, analytical, and more or less mechanical. The union of psychology, as psychology then went, with physics and a physically disposed physiology, was exceedingly fruitful in so far as the discovery of facts was concerned. Psychology did, indeed, become a science; but unfortunately it did not find a definitive point of view from which to consider its facts as a whole. Its models were physics and physiology instead of the biology which still lay in the future. The concepts of organism, of evolution, of biological adaptation, and the like hardly touched psychology in a significant way during its formative period.

In recent years experimenters have looked with increasing favor upon psychology as a biological science. Instead of taking life for what theology and philosophy said it was, men have been taking it more and more for what they actually find it, viz., a natural part of a natural world. This view has, of course, necessitated a change in our way of handling certain ideas and concepts, and in order to understand what follows we must assemble some of these concepts and consider their relationships.

The concepts of the traditional psychology appear to fall naturally into several groups. (*a*) The words sensation and perception (seeing, hearing, touching, tasting, and smelling, size, distance, movement, etc.), fall naturally together. (*b*) Likewise learning, habit formation, memory, recall, recognition, skill, and practice usually appear in a single section of current psychologizing. (*c*) Attention, interest, choice also fall together. (*d*) Mood, emotion, passion, and sentiment form another chapter of the standard texts. Two closely related groups of facts are (*e*) imagination and (*f*) thinking, reasoning, judging, reflecting, and the like. Finally (*g*) the words personality, self, character, appear in the concluding chapters. In addition to these facts of "pure" psychology one can usually find in the textbooks varying amounts of physiology, neurology, and a good deal of reference to human or animal behavior. Action, which is a psychological name for behavior, has occupied an anomalous place, being classed now with emotion or again independently. Will has also had no certain home.

These words, by their history and by their systematic place in philosophies, reflect tradition rather than a plain account of what is observed in animal behavior. And yet they do refer to different intellectual talents. Modern psychology and especially biologically and behavioristically minded psychologists have been vexed by the problem as to what to do with them. Little is gained by the invention of new words and yet old meanings cling tenaciously to old terms. We may help ourselves a little in understanding what follows if we think of the *talents* which these words imply rather than of the psychological and philosophical theories about the talents which are suggested by the words.

Seven Observations About Animal Behavior.—What are these talents of which we are to think? They are at least seven in number and may be summarized as follows: (*a*) Each creature has created for itself an *effective* environment which has certain limitations or boundaries set by the nature of the creature itself. Within this effective environment living creatures are able to make rougher or finer discriminatory reactions (Sensation and Perception). (*b*) Under certain conditions the original nature of each creature may become more *appropriate.* That is, the creature learns (Learning and Memory). (*c*) Under certain conditions living creatures may prepare now for an event that is yet to come (Imagination). (*d*) Under certain conditions, some external to the organism and some internal to it, parts of the environment may become prepotent in determining behavior (Attention). (*e*) Under certain conditions a reaction may be postponed pending a thorough reorganization of behavior patterns so that the final behavior may be most appropriate (Thinking). (*f*) Under certain conditions the energies of the organism may be varied to meet crises. That is, the organism assumes attitudes or falls into dispositions with respect to situations, and the resultant behavior is toned or modulated accordingly (Emotion, Mood). (*g*) All animal behavior is *characterized* by total dispositions or by selfhood and personality differences (Character and Personality). In addition to these seven phases of behavior there are the debatable facts of self-initiation, will power, and freedom of the will. But let us proceed to exemplify these seven phases of behavior. The reader recognizes in them, of course, the seven traditional chapters of psychology. This is natural, for a biological psychology has not discovered anything about animals that is fundamentally new. The point at issue is how intellectual talents shall be described and explained.

Problems of Perception

The first thing that strikes us in our closer study of the three samples of behavior listed above is the following: each of the creatures before us has a different effective environment, an environment which is distinctively its own. To take a single example, the amœba appears to be unaffected by the sounds of our voice, the ape responds in limited ways to certain sounds only, while the doctor will, on occasion, respond in many ways to every sound we are able to utter. The amœba responds to a limited number of objects or events in immediate contact with its body, the chimpanzee to these and to a great many more, many remote from its body, while it can be demonstrated that the doctor will adjust himself to an extraordinary range of events and objects both near and remote.

The Effective Environment.—These observations raise many questions. One of the first problems of psychology always has been the determination of the effective environment of any creature, that is, the range of objects, events, or processes which may elicit from any given creature some sort of response. Assuming that we already know our physics, physiology, and anatomy we may ask: What is the range of auditory, visual, gustatory, olfactory, tactual, and organic receptivity of a given creature? In the history of science these problems have fallen in part to physiology under the phrase "sensory physiology," but in part also to philosophy and psychology under the names "sensation" and "perception." To ask how many qualities of sensation there are, or how many perceptions there are is to ask about the range of the effective environment of any creature.

In our own case the world about us seems to be full of something to react to. There are no "empty" holes, no places where there is nothing to act as a stimulus; but the same is probably true of all animal creation. This is not an illusion. On the other hand, however, there is much to react to of which we know nothing directly. If we think of radiant energy alone, we shall find that we are able to make reactions to only one octave out of the fifty-five which physics describes. We are able to make no reactions whatsoever to magnetic and electrical fields. Some animals produce and react to wave lengths of sound which are inaudible to us. In other words, the environment which the physicist describes is far greater than the effective environment of any known creature. In both human and animal psychology it has always been a pretty problem to determine the range of this effective environment for any given creature, *i.e.*, to determine what it can and cannot react to.

The Visual Perception of Distance.—On page 119 we shall tell of a point of view in psychology which makes it appear that human behavior is determined almost entirely by the stimulus. The stimulus is said to act and the organism reacts. In this we cannot agree. The behavior patterns exhibited by living creatures are not a simple reflection of the stimulus patterns; they reveal the fact that the organism itself has talents which enable it to meet the stimulus patterns more than halfway. It is for this reason that we chose the expression $x = f(y)$ as a suggestive analogy for the relations which obtain between an organism and its effective environment.

We may illustrate these facts by the perception of distance. There is outside of the body no object or form of stimulus which, in and of itself, is distance. Objects are perceived as more or less distant from the body, but there is no form of "distance stimulus" which will, when taken by itself, set up an appropriate response. Nevertheless we see directly and without delay the house across the street, the automobile that is approaching from a distance, or the golf ball that is flying down the course. It becomes pertinent, then, to inquire how the organism is able to adjust itself to the nearness and farness of objects and events.

Under experiment we discover first certain accessory objects and events which contribute to the problem. Small objects are said to be remote when compared with near, large objects. Haziness and indistinctness are often taken as signs that some objects lie farther away than sharply outlined near-lying objects. Then, too, remote objects are often cut off by near objects and other spatial arrangements of objects make other contributions to our perception of depth.

But these are all properties of the environment. The body plays even a more important part. Under experiment it is discovered that two retinas are quite essential to anything like accuracy in tridimensional perception. During the acts of accommodation and convergence the two eyes are thrown upon a single object; but the fact that the eyes are separated by a few centimeters makes it impossible that they should ever get identical images of one and the same object. A different picture is thus projected upon the two retinas and it turns out under investigation that this disparity of the retinal images is one of the essential conditions for the production of depth or of stereoscopic vision. That is to say, "*it is as if the two eyes had reconciled their conflicting views and the result were depth or solidity.*" [1] To this disparity of the retinal images must be added (i) the muscular strain incident to the physiological acts of convergence and accommodation and (ii) a nervous set or disposition which may be the product of learning.

Perception of Movement.—Consider the following observation. You look out of the train window and the landscape appears to be flying by. As a matter of fact, you are moving with the train. The figures upon the screen appear to be moving but you know that, as a matter of fact, there is only a succession of pictures being presented in each of which the figures are standing still. The film moves, but the figures do not. You are waiting for the traffic light to change, and as the red disappears and the green appears it seems as though the red moves up to the green. You shake your head from side to side, but objects stand still. If, however, you move the eyeball from side to side with a finger pushing at the edge, objects will appear to move. If you twirl rapidly about on your heel and then suddenly stop, objects will appear to be moving in the opposite direction.

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[1] Titchener, E. B., *A Beginner's Psychology*, 1916, p. 128.

Apparently the resources of the organism for reacting to movement are almost without end, and it can easily be imagined that this group of perceptual problems has offered unusual difficulty to the psychologist. Of at least three conditions which excite a reaction to movement we have some knowledge. We know that verbal or manual reactions may be aroused (*a*) when an image of an object actually moves across the retina, (*b*) when the movement of the body or of an object causes certain types of eye-movement, and (*c*) when two objects lying near together appear one after the other in rapid succession. In each of these cases the perception of movement itself and the reactions which are made to moving bodies owe their origin in part to what is actually happening in the environment, and in part to what is happening in the organism.

Problems of Discrimination.—In addition to problems concerning the extent of the effective environment, there are also problems touching upon the ability of any creature to make minute discriminations between stimuli of variable values. It is one thing to determine the boundaries of perceptual ability and another to determine differential responses within these boundaries. The first problem was a heritage from philosophy, but the second was, as we shall see in Chapter II, the point at which the new psychology laid hold of the experimental method. One of the questions which the first experimenters asked was: How small a change in the intensity or in the quality of a stimulus will be just noticeable?

It is the extension of this question to every mode of perception that has built up that vast branch of psychology known as psychophysics. Fechner thought that he was measuring the intensity of a sensation but we see now that he was really measuring the talent of an individual to make discriminatory reactions (verbal or manual) to slight changes in the experimental situation. We shall come back to the significance of these experiments on p. 61.

Problems of Learning and Memory

The effective environment of human beings and of some of the higher animals is not limited by the objects and events of the immediate present. This is a spatial extent which it has, but there is also a temporal extent to the environment of all higher creatures. All living creatures are so made that they carry their own past with them. This means that the effective environment may include not only that which is present but that which has been present. The two words which describe this fact are memory and learning. Whether psychology is face to face with two different kinds of talent, or whether learning and memory are cut from the same piece of cloth remains to be seen.

Even more significant than this *rearward* temporal extension of the environment is its *forward* extension. The present object points to the future. We may make preparations now for an event that is yet to occur. Here, too, psychologists are in doubt, for it is not known whether this prevision is a unique intellectual talent or whether the facts of learning and memory are adequate to account for it. But let us enter a little further into these matters.

Learning.—Had we time to extend our observations of the amœba, the ape, and the man beyond our allotted five minutes we should soon discover that the behavior of each creature (certainly of the last two) is variable in a double respect. No creature is performing the same movement from moment to moment through the livelong day. There is a constant variability of reaction because there is a constant variability of situations to which one may react. But when the same reaction does appear we find that it may be different, different in the sense that it is better. We admired the skill with which the doctor avoided running over the child. We admired also the general smoothness and efficiency of his movements as he went about the task of rendering aid to the injured. Had we observed his first attempt to drive an automobile or handle his instruments we should have found him, no doubt, remarkably awkward. Since his first trial he has acquired skill. He has profited from past experience.

We should find these same observations true of the ape if we were able to observe him from the time he begins any new reaction pattern until the time he has acquired some proficiency. We shall leave open, for the moment, the question as to whether the amœba also shows improvement in its reactions under practice. But the main point is clear. It is characteristic of animals to *learn*. In addition to reacting to an environment of a given extent and in addition to reacting to prepotent parts of this environment, a creature is able to make *increasingly appropriate* responses to it.

Original Nature.—The fact that, under certain conditions, all living creatures better themselves in their behavior, that is, become more efficient or more skillful or more learned, presupposes a starting point, viz., original nature. Here we touch, on the one hand, the problems of physiology and, on the other, the problems of genetic psychology. We shall, therefore, assume an original nature which includes (*a*) fairly definite simple reactions known as reflexes, and (*b*) certain patterned reactions known as instincts. All living organisms take up the burden of life with this original nature or with simpler equivalents (tropisms).

Maturation.—Even at the moment of birth it is not always easy to say which of the random movements of a creature are original or are the product of a normal process of growth or maturation and which are learned. Maturation means that the organism matures in its action patterns without any pronounced intervention of that process we call learning. Young chicks, for example, which have been prevented from pecking for three days after hatching, acquire in a few moments as much skill as other members of the brood which have been allowed to peck at will.

Memory.—We have been concerned up to this point with a profit from experience which requires a certain amount of practice for its establishment. Living beings do not always have to be put into the same situation over and over again, however, in order to make the situation useful. It often happens that *once* is enough. Memory appears, then, to be a special form of learning (limited only to the higher animals) in which (*a*) the stimulating situation and (*b*) the organic state of the body, and particularly of the nervous system, are such as to guarantee a more or less permanent alteration in the reaction system of the creature. Most of the experimental work in the general field of learning has been limited to the acquiring of special skills, and there is very little that can be said about memory proper.

The fact of memory is plain and straightforward. We see today a beautiful picture. We see it but for a few moments as we pass along the gallery. But tomorrow we can "see" it again although we are miles distant. And the picture we see comes back to us with a date upon it. It is that picture which we saw *yesterday* in the large room at the corner of the building. All true memory bears this dating of the past, this mark of familiarity which makes us say, "I have seen that picture before. It was at —— etc." Or we say, "Oh! I remember now. The person you mean was the person we met at —— etc."

On the side of mental life, memory means the appearance in mental life again, and with more or less fidelity, of those sensational and imaginal processes which were aroused at the time of the original perception. The whole memory picture may be washed out, or it may be a skeleton only of the original object or event; but such processes as are present point to or signify the original event. The feeling of familiarity is said to be carried by organic processes which are, perchance, a revival of the accompaniments of the original attitude.

Learning and Memory.—We have distinguished the problems of memory from those of learning by saying that memory appears to be a special case of learning where something happens to the organism under a single appearance of some object or event. The scene is *once* viewed, the opera *once* heard, or the meal *once* eaten and a memory of the event is "retained." It is a curious fact that the memory is almost always a visual memory, a fact which has been familiarized by the phrase "the mind's eye." We explain memory by supposing that the cortex is thrown into a certain state (see p. 155) and that any circumstance which serves to re-create this state or condition will, of necessity, bring back into the stream of mental life a part, at least, of the mental events that originally accompanied this particular neural condition.

To say that memory is a special case of the phenomena of learning is, of course, to side-step the whole issue. Learning does appear to be a bodily affair and memory appears to concern something mental. This fact however should not be confusing, for the memory task involved in learning means that the nervous system and the effector organs, that is, the muscles, contribute to the process, while the learning process involved in memory concerns, so we may believe, the cortex of the cerebrum. In any case, it is not necessary to assume that memory involves processes that are *purely* mental. To say that learning is bodily while memory is mental is to draw a distinction like that which is often drawn between thinking as mental versus perception as bodily, or between perception as bodily (objective) and feeling as mental (subjective). As learning proceeds the amount of processual accompaniment grows less and less. It is not known whether this means that the functions involved drop down to lower brain levels or not; but in no case do we have any convincing reason to believe that life suddenly abandons its nervous systems when creatures wish to remember rather than to learn. This matter will become a little clearer before we have finished the next chapter.

IMAGINATION

Previsory Behavior.—Profit from past experience means not only that we are tied to the past but also that we may anticipate the future. Living in terms of the past and in terms of the future are so intimately related that only the arbitrariness of description is an excuse for separating them. Had the doctor spoken when he returned to his office we should have understood him to say that he might have occasion to use the instrument for which he returned. The whole act of taking the kit is not only a testimony to habit but a testimony to the fact that a present mode of behavior is a preparation for an event that has not yet taken place. The very act of turning out of the way of the child which ran into the street, the act of taking the less crowded thoroughfare instead of the shorter and more direct street—both look ahead of the immediate situation. So far as we know, the amœba has no way of looking very far ahead of an immediate situation. The situation appears, and it is responded to with the properties of behavior which have already been described. But rarely, if ever, does the amœba take a present stimulus as a sign or a signal of an event that is yet to happen. In the behavior of the ape we begin to find clear evidences of this ability to previse the future, to take a present situation or event as a sign that something will shortly happen for which preparations can be made in advance. In the case of the human being such previsory behavior is a common thing, so common in fact that it has been taken as one of the distinctive features of human behavior.

Imagination and Previsory Behavior.—Imagination is probably one of the most misused words that psychology has ever had in its vocabulary. According to traditions we find that it has often been used to designate a random flow of memories. It has also been used as a substitute for day-dreaming, and for fantasy. These too belong to the uses of memory rather than to those of imagination. Finally, imagination has been identified with a certain kind of problem-solving. We are using it in much the same sense as that described by Angell (see p. 116). Organisms, and especially the higher organisms, do appear to have a distinctive talent for seeing in a present situation an event that is yet to occur. Seeing the future in this way means that the present can be used to prepare for the future, and this is a unique talent.

Imagination, even as we have defined it, does not mean divination. An animal that has had no past would likewise have no future. Its temporal boundaries would be limited as are those of the lowest animals. It may be supposed, therefore, that learning and memory furnish the materials which are used in prevision of the type we are considering. This has been recognized often in the history of psychology by the statement that it is impossible to think of anything genuinely new.

Problems of Attention and Interest

We have seen how certain stimuli, because of their intensity or quality, become prepotent over the general environmental situation in determining the responses of amœba. Likewise a piece of fruit, or a box, or stick appear to earn for themselves a distinctive place in the perceptual world of the ape. Only certain instruments and certain streets offered an invitation to the doctor. We may generalize and say that rarely, if ever, is a creature responding with its whole reaction system to the whole of its environment. On the contrary, living creatures always appear to be adjusting themselves in a specialized way to some specified part of their environment. There is always a process of selection at work, a process directed now toward the environment itself and now toward the organs of response. We come, then, to a fourth characteristic of animal behavior or to the problems of attention and interest. We are led to ask about the conditions under which certain parts of a creature's environment stand out and become determining agents in exciting appropriate adaptive responses.

Attention and interest refer to two sides of the general problem of selection. We know in a general way that new, strange, sudden, moving, intense objects or events demand and secure priority in the action system of a creature. Thus, in a general way, we find the problems of attention. We know also that organisms are at various moments variously disposed toward the reception of stimuli, that is, more or less ready to settle accounts with one part of the environment rather than another. Thus we define, in a general way, the problems of interest.

Attention is ranked high among human talents, for the human being alone has learned how to allow memories, that is, his past experiences to become prepotent over the present. "Implicit behavior" means that movement systems and reaction patterns that have been formed under the influence of previous conditions may become prepotent over similar systems and patterns aroused by the "specious present." What is done with these internal systems falls under the problem of thinking.

Thinking

Thinking is not simple remembering. If, while Sultan looked on, we had buried a banana out of his reach and brushed the place over so as to make it indistinguishable, he would nevertheless on the next morning have gone to the place and dug out the delicacy. This is not problem-solving. The surgeon who suddenly turned around and went back for another instrument was not thinking. He was, however, making a provision now in order to meet a situation that had yet to occur.

Problem-Solving.—Thinking means problem-solving. It means the reorganization of memories and behavior patterns in unique ways so that new situations can be adequately and appropriately handled. The man who first saw a fractured leg and had to devise an adequate way of binding it was solving a problem; he was thinking. Sultan was thinking when he used boxes to build a pyramid in order that he might find fruit. He was reorganizing old behavior patterns into new so that he could cope successfully with the new situation. (Habit leads us to say that a man or an animal reorganizes memories and behavior patterns in this way. It would be more suggestive and perhaps more accurate to say that they become reorganized, not that we reorganize them.)

Constructive Delays in Behavior.—Thinking means, then, a constructive delay in response. It is characteristic of all the plants and of the very lowest animals that they are intimately and immediately dependent upon their environment for incentives to movement. Assuming that conditions internal to the amœba, for example, are constant, it cannot help but make an immediate response to a stimulating agent. There is only a slight physiological inertia to overcome, just as is the case with any object that is at rest. But as we consider the ascending scale of life, we begin to find signs of a temporal separation between stimulus and response. This temporal separation appears to be conjoined with the origin and the development of that kind of nervous system which we know as the synaptic system (see p. 192). The synapse, as we shall see, offers resistance to the passage of certain nerve currents and the blocking of a direct way through the nervous system (when taken in conjunction with learning) may mean that the ultimate discharge into the reaction system is a discharge tempered by a multitude of conditions obtaining within the central nervous system. So it happens that life has divorced itself more and more from the environment. During the delay between stimulus and response the pattern of response may be changed under limits that are set only by the limits of the cerebrum itself.

Emotionally Toned Reactions

The physical energy embodied in a stimulus or in a pattern of stimulating agencies (experimental situation) has no stable relation to the energy embodied in the response of a creature. The all-or-none principle of nervous action means that if a stimulus is intense enough to excite a nerve-current at all, the nerve will respond with its total available energy. Similarly, differences in the intensity of the contraction are due not to differences in the intensity with which any single muscle fiber contracts, but to the number of contracting fibers. Each fiber contracts with its whole energy or not at all. Here are two ways in which the energy of response may have an unstable relation to the stimulating situation. But the organism has still another means of determining the tonic variations of response, viz., through the glands of internal secretion. Thus we may say that the process of getting-on in an environment runs off at variable energy levels, sometimes slow and dull (lethargic) and sometimes quick and violent (choleric).

Amœba responds to a violent stimulus with a more than equally violent response. The chimpanzee responds to the situation "stick that can't be drawn through the screen" with angry and violent movements. The doctor swerves out of the way of the child not only with skill but with unusual vigor. In other words, the energies of the body are everlastingly brought in variable amounts to the aid of the organism, depending upon the nature of the stimulating situation. This fact introduces us to problems which in the history of psychology have been known as problems of emotion, passion, mood, disposition, and the like.

Emotion.—An emotion is a major attitude of a living creature brought about in part by a fearful or provoking or saddening situation, and in part by the facilities which the organism has for equating its energies against the character of the situation which is presented. It is probable that the original attitudes, *i.e.*, the native inborn attitudes are few in number, but because of a process of conditioning (see p. 236) a great variety of objects come to be effective in setting up these attitudes. It has been shown, for example, that infants are not innately afraid of the dark, and yet darkness along with a multitude of other situations has come to be effective in exciting the fear attitudes.

The problems of emotion have been confused in psychology, for there has been no agreement upon what shall be taken as the primary fact. The organism does make a fear response, which means that the energy reserves of the organism are brought to its aid upon the appearance of a fearful situation. But we also have an experience of fear, an experience which certainly is not the response. This problem of the relation between an emotional experience and the so-called expression of the emotion (the bodily reactions) was made an issue by James and Lange in a theory which each devised independently of the other. The tradition had said that the emotion as an experience was felt, and that it led to or was accompanied by the expressive movements. James and Lange maintained that the organism attempted to meet certain situations with all the devices at its command, and that the resulting bodily movements and correlative glandular changes were experienced as the emotion. That is, fear as an experience was our way of being conscious of what the body was doing in its own defense. This theory gained a great amount of popular fame from the paradox that we are sorry because we weep, that we are frightened because we flee, and so on.

Moods and Sentiments.—The problems thrown into psychology by emotionally toned behavior become clearer when we consider the relation of mood and sentiment to reaction patterns. Moods and sentiments are mild attitudes which are sustained over long periods of time and which lend a more or less permanent tonus (in many qualitative varieties) to the performances of a creature. That mood which we know as the joyful mood means that the creature is attitudinizing in a distinctive way with respect to the changing moments of its environment. It is easy to see that these attitudes play an enormous part in the quality of animal behavior.

PROBLEMS OF PERSONALITY

Were we to have, under our microscope, a half dozen amœbas instead of one, and were we to spend several hours observing our subjects, we should find that, in spite of the simplicity of their behavior, we could separate or distinguish one from another by certain characteristic ways of acting, little peculiarities in behavior that are not taken account of in the average picture which we might otherwise draw. This individual difference in behavior appears much more clearly with the apes. By observing two or three subjects a short time we learn what to expect of the one and what to expect of the other. We can always say that subject A will be energetic, alert, apt in its behavior while B is ordinarily slow, dull, unimpressive. These facts are true in immeasurably greater extent among human beings. Every living creature falls into certain habitual ways of meeting its environment. We can depend upon a creature, once we have seen it at work, to continue for appreciable lengths of time reacting in the same total way. These observations introduce us to personality or to the problem of patterned behavior. Personality is a name which we use when we wish to keep before us the fact that living creatures are never exactly alike even though they come from the same family and live in the same community.

The Organization of Behavior.—It is only under the best experimental conditions that a single isolated stimulus can be presented to a subject with the hope of arousing a single isolated response. This is true in spite of the fact we have already discussed, viz., that under normal conditions the organism tends to select certain objects and events to the exclusion of all others. Selection there is, no doubt; but supplementary to selection is the fact that objects come to the organism in patterns, are reacted to as patterns. Moreover, the responses themselves are never isolated responses but always organized, integrated patterns of response.

The organization, the patterning, the integration of animal behavior is one of the most unique characteristics of the behavior of living creatures. We find it in all degrees of complexity. We may begin, for example, with the fact that the several members and organs of the body often conjoin with one another either temporally or cross sectionally in a total mode of behavior which must be taken as a unit. The playing of a melody requires both a temporal and a cross sectional organization of a great variety of finger, hand, and eye movements which in the final rendition of the piece give it a distinctive and total character. The personality of the composer thus finds expression in what, after all, is a comparatively simple behavior pattern.

Secondly, the facts of memory and of learning, as we have already described them, mean that a present reaction of a creature is not only the product of the stimulus and of the immediate equipment of the organism for response, but it is also a product of the history of the organism as well. Thus the present is tied to the past. Thus we *are* our history.

These facts were once expressed by saying that man is a "self" or that he has a "soul" which is the core of him. We find, however, that man is a unique integration of habits and skills. The experimental problem in personality is to trace the process of building this pattern, disclosing the factors that are determinative in it. It is an old belief but a new discovery that some of these factors are glandular. Character and personality owe their uniqueness to habits of thinking, and to other skills and habits, but also to prevailing moods and emotional tendencies. The ancient division of men into melancholic, choleric, sanguine, and phlegmatic types was a prophecy of the day when men should begin to find in hyper and hypothyroidism a physicochemical basis for that difference in total behavior which makes some persons nervous, excitable, flighty and other persons, dull, inert, unimpressive.

Light upon patterned behavior has been shed also by modern researches in abnormal psychology. If normal mental life and behavior is thought of as issuing from a well-organized and closely integrated action system, mental disease may be thought of as issuing from a reaction system which is divided against itself. This matter we shall consider in Chapter XIII; but in the meantime we must not forget that the modern psychology of personality, self, or character is just as much an experimental psychology as any other phase of the study of behavior.

The problems of self, personality, character, and the like are suggested in the following quotation: "The individual nervous

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system possesses, over and above its special habits, susceptibilities, tendencies, and activities, a characteristic manner of functioning at large; so that a common or general factor enters into all the special intellectual responses that are called forth by particular situations." We shall add that this "common factor" may easily be thought of as entering into all of the responses of an individual, and thereby we come upon the problem of personality or self. Over a long period of observation we find that different individuals have certain preferred ways of acting and certain preferred types of environment which are characteristic of the individual concerned. That is, the behavior of an individual during the course of a year or of a dozen years presents a certain type of coherence which we do not find when we pass quickly from one individual to another. It is this coherency which we call character.

The Problem of Freedom

It is clear from what has been said that the organism is in no sense a passive agent in its environment. The mode of reaction, for example, is often determined, not by the environment but by the energies of the organism and by the disposal of this energy within the central nervous system. Moreover, certain parts of the environment are singled out, not merely because they are intensive parts but because the organism has its own devices for favoring some objects to the exclusion of others. Tradition gives us the word interest, a word which describes this initiative on the part of the organism. The tendency in some quarters to take the organism as a passive agent may have sprung from that sort of plasticity which underlies memory and learning; but opposed to passive plasticity there are the emotional resources of the organism which lead to changes in the tonic level of response quite apart from the intensity of the stimulating object or agency. The organism must be credited for what it is, viz., an organism with its own organization, its own sources of energy. It is, in spite of its community with the world of nature, an independent unit and it is not unreasonable to expect that such an independent unit should have powers of initiative or dynamic powers characteristic of it just as other semi-independent worlds set themselves against the rest of the universe.

Are Organisms Self-Initiating?—We have to consider the fact, then, that the organism is in some respects self-initiating in its activity, that it is in some respect or other a dynamic agent. There are several such instances of apparent initiative in the examples that have been given of the behavior of living creatures. Our doubts are not about the fact of initiative but as to what the fact means, how we shall understand it. We shall be distressed here all the more because some psychologists have taken this fact of dynamic agency, of self-initiative, as the cardinal fact in psychology, as the point of reference for all that living creatures can do. The history of psychology has paid its respects to these problems by speaking of free will and choice.

The Bodily Energies.—It becomes appropriate, then, to ask to what extent the organism and particularly the nervous system is an independent, self-initiatory agent in its relations to the environment. We may begin by comparing the nervous system with other major organs or instruments of the body, for it is not likely that brains are possessed of modes of operation wholly unlike (qualitatively unique from) the modes of operation of other organs and structures. So far as we know at present,—and the physiology of the stomach, of the intestines, the heart, and the lungs is much better known than the physiology of the nervous system,—none of the organs of the body are self-initiatory in their action. The digestive functions of the stomach begin with the presence of food. The hunger contractions begin with the absence of food, or more correctly, either with the stimulus of the sympathetic system or because of the habit that has been formed of receiving food at certain stated times. The lungs are kept at their work of respiration by the carbon dioxide content of the blood which passes through them. We are not so certain of the agencies which stimulate the heart, but it looks as though the carbon dioxide content of the blood is the effective instrument here also. In view of these facts of general physiology, it would be unreasonable to assume that the nervous system is capable of independent functions which it must initiate if it is to act as certain theories of will and of purpose would demand.

What precisely are the conditions under which the nervous system appears to act independently and autonomously? One may remark, in the first place, that almost all of the bodily operations go on at rates and with a consumption of energy that far surpass the energy of the original stimulus. The whole body is a storehouse of energy and this is particularly true of the muscle tissues, and all of this energy is, under certain conditions, available to the organism even when the stimulus, physically regarded, is wholly out of proportion to the work done. It may be remarked, in the second place, that the lapse of time between the stimulus and the response, as in thinking, often gives the appearance of action unitiated by an object or situation in the environment. This is probably the most frequent source of the illusion that human action, in particular, is often creative and free. In the third place, we have seen that stimuli which are exceedingly remote from the organism may become effective agents in bringing about a relevant adjustment. The eye is a "telepathic" sense organ. We observe the response without having considered the possible remoteness of the exciting agent or situation. In the fourth place, we have found that bodily movements improve under practice, that responses become more appropriate with use, and that, therefore, not knowing the history of any particular piece of skill or the origin of a particular memory, we may attribute the appropriateness of behavior to self-initiative. Finally, we must admit that there are infrequent occasions on which an apparent independent action may occur. A very simple case would be a muscle twitch which has an organic rather than an external cause. What takes place in the metabolism of the muscle or the attendant nerve fiber may take place also in the brain; but it is clear that such rare events could not contribute much to the pattern of animal behavior, to say nothing of that sort of behavior which we call intelligent.

Mental Freedom.—So much for freedom in so far as it concerns behavior patterns! But this does not answer all questions, for it is "mind" that is said to be free, not body or nervous system. And mind, being free, can cause the initiation of action by effecting changes in the nervous system. This is, of course, another question, and since it involves facts and theories which we have not yet discussed we shall postpone further consideration of it until the next chapter.

A Definition of Intelligence.—Intelligence is usually described as something which a person has, just as he is said to have a mind. It is clear, however, from the preceding paragraphs that a psychology which claims relationship with biology, or a science which describes how animals get on in an environment, has little to say about an intellect of the order of minds or souls. Intelligence is something that an animal is, something that it does. The scientific problem is not to search out some mythical agency which makes it what it is, but to describe in what way it is intelligent, or how it acts in order that it may be called *more* or *less* intelligent. Animals are more or less intelligent according as they adjust themselves to their environment in the variable ways in which we have described adjustment as going on. Intelligence is not, then, something that a person *has* but something that he *is*. Intelligence is a judgment which we make about other creatures when we try to evaluate their skill in adjusting themselves to an environment. The fact that our judgments are purely arbitrary can be seen in the fact that we choose variable adjustment to a variable environment as the surest sign of intelligence. As a matter of plain biological fact, the ants are better adjusted to their environment than we to ours, but we do not like their kind or mode of adjustment. We count ourselves, therefore, more intelligent, or more highly developed.

Contrasts between the Organic and the Inorganic.—The word intelligence thus becomes the name, not of the variable quantities of a thing or an agency or power which animals possess, but a name for a certain excellence which they display in a certain kind of task. It will be illuminating to consider the contrasts between intelligent and non-intelligent behavior in a little more detail. We have said that living creatures create for themselves an environment in that they are prepared by their own structure to make responses to a part of the energies lying about. But non-living objects also have an environment. The magnet settles its accounts with the iron filings by drawing them closer and seeing that they are arranged into suitable lines; but the magnetized horseshoe does not get out of the way of the coming automobile tire. The golf ball and the billiard ball do not get out of the way of the club or of the cue ball that is just caroming off the edge of the table. The baseball appears, at times, to get out of the way of the bat, but the physicist says that this is only our illusion, that as a matter of fact, the air has so piled up behind the ball that it must slip to the one side or the other. We have said also that living beings exert a certain selective power in their adjustments. The magnet too selects only certain kinds of metal, but it does not select one nail out of a pile as does the carpenter. The billiard ball does not select one pocket rather than another in the same way that the automobile driver selects one opening in the traffic rather than another. The billiard ball moves every time the cue moves, not in parts but as a whole. It literally hurls itself at the next ball or at the pocket. The living organism, on the contrary, may or may not respond immediately to a stimulus and it rarely hurls its whole structure at the stimulating agent. We have said that living creatures profit by their past experience, that is, they learn. But iron rods also learn. If an iron rod is bent and the straightened end is again put under stress it will bend in the same place. But this "memory ability" of the iron rod is extremely limited and fixed as compared to the ability of living creatures. We might expect, of course, that many of the properties of living substance should also be the properties of non-living substance, and here, no doubt, is such a case, for we are dealing with plasticity and with the preservation of previous displacements or modifications of material. But the universal fact of plasticity and of retention is not a bridge over which one may pass at will from the organic to the inorganic.

All of these are rather unsatisfactory inorganic parallels for certain types of adjustment of living creatures. But there are also types of adjustment for which there are no convenient inorganic parallels. Living creatures respond with an eye on the future. A present fact may mean a future event; it may imply present preparation for a future contingency. There is nothing in the inorganic world that resembles this mode of behavior, and neither is there any resemblance in physics to what we have called delayed behavior. We find, it is true, in the inertia of all objects a parallel to physiological delay. Living creatures, too, are subject to inertia but they have built another type of delay upon this foundation, viz., that type which conditions the process of thinking or reasoning.

Finally, the behavior of living creatures is characterized by a certain unique type of patterning. This is a characteristic of behavior which again touches upon the properties of the inorganic world, for the world is not a chaos. We should not expect living beings to be any less organized than the stuff from which they came. Stimuli come in patterns and the organism meets stimuli more than halfway by responding in patterns. There is a wholeness, or a unique totality about this patterning, however, that is not paralleled in inorganic types of behavior.

As we have said, we should not expect the differences between the mode of behavior of non-living stuff to stand wholly in contrast to the modes of behavior of living creatures, for life is a continuation of the inorganic. But we should expect to find as great improvements in behavior as we find improvements in the total properties of life and matter. Life persists in a little more unique way than matter. Life grows in a little more unique way than crystals. Life reproduces itself a little more uniquely than storms reproduce themselves. So with behavior.

Living creatures have gone on beyond their parentage, and this *more,* this *uniqueness,* we call intelligence.

Intelligence, then, becomes coextensive with life. So long as creatures are having any sort of intercourse with their environment they are being more or less intelligent. They are not having more or less of mind; they are behaving with greater or lesser excellence. Thus it is easy to see how intelligence may have degrees, and what is more, degrees that admit of some sort of measurement. *More* or *less* come to have a positive determination, not the mystical determination they once had when men spoke of more or less mind. A *big* mind for human beings and a *little* mind for animals always was a problem that taxed our credulity. Intelligence is not a thing possessed by organisms but a judgment we pass upon them with respect to their modes of getting-on. Growth in intelligence means growth in variability of adjustment to a variable environment.

Definition of Psychology.—The several problems of the anatomist, the physiologist, and the psychologist can no more be cleanly severed from one another than can the problems of the physicist and the chemist. The colors in the physical spectrum shade into one another just as anatomy runs into physiology and as physiology runs into psychology. The anatomist takes the living creature bit by bit, piece by piece. Cells and their parts, the structure of the several vital organs, the plan of architecture of the whole bodily frame, comprise his field of observation. At this point the problems of anatomy merge into those of the physiologist. The latter takes the organism function by function, mode of operation by mode of operation, and finally he considers certain aspects of the plan of operation of the whole creature. The physiologist gives the psychologist a functioning organism, a breathing, digesting, growing creature, a creature ready to become a functional part of an environment, a creature ready to invite judgments about its talents. Living creatures, as they leave the laboratory of the physiologist and become a functional part of an environment, create for themselves a smaller or greater effective environment, they show themselves to be more or less talented in selecting parts of their environment for immediate consideration, they profit from past experience more or less readily, they look into the future more or less distantly, they are more or less talented in inserting effective and fruitful delays between stimulus and response, they are more or less talented in tempering responses to the needs of the moment, they are more or less talented in organizing their responses to total situations, *they prove themselves to be more or less intelligent.* And thus the general problem of psychology may be defined as the study of intelligence.

Psychology is the science of intelligent behavior, not as men, animals, or children, are intelligent, but as life in the large is intelligent. Intelligence is not something that life *has* but something that life *is.* Psychology thus becomes a branch of biological science, a science that stands upon the same footing with the other natural sciences, both as regards its subject matter and its methods, and as regards its ultimate metaphysical foundations. It is a science that treats of certain natural phenomena in a natural world. Just as there is one science of physiology which treats of physiological functions of various sorts without an internal break in logic or method, so there is one science of psychology which treats of a whole group of facts without breaking its logic, its assumptions, or its method in order to get from one group of observations to another.

CHAPTER II

A BRIEF SKETCH OF THE ORIGINS OF EXPERIMENTAL PSYCHOLOGY

Introduction.—We are now acquainted in a general way with the major problems of psychology as they appear when we take living creatures as *natural* objects in a *natural* world. We have found that, from the biological point of view, the general problems of psychology come out of a unique functional relationship which obtains between two independent variables, viz., the environment on the one hand, and a living creature on the other. By attributing certain values to the environment, that is, by instituting certain experimental situations, we have found that we are able to discover an unbelievable number of facts about animal and human intelligence; but before we consider the import of some of these facts it will be worth our while to learn something of the history of psychology, that is, to hear again the first questions that were asked and to listen with more knowing ears to the first answers that were given. Men have not always thought of psychology as a biological science and they have not always thought of living creatures as natural objects in a natural world, and it will be of profit to us, therefore, to share once more the points of view from which the founders of psychology looked upon their work, to think their thoughts after them, and to temper our own thoughts with respect to them. We shall not be able to understand the full meaning of different groups of facts, and different points of view, and neither shall we be able to get a faithful picture of the whole field of psychology unless we find out where differences of opinion have come from and why they continue to exist as persistent problems of psychology. We shall consider in this chapter, then, a brief sketch of the events which brought psychology into sciencehood and which have determined its progress up to the present time.[1]

The Birth of Experimental Psychology.—Wilhelm Wundt mentioned, one day, to his friend and colleague, Fechner, that he hoped soon to found, at the University of Leipzig, an experimental laboratory for the study of psychological problems. Fechner replied with astonishment: "If you do that you will be through with the whole of psychology in a few years." This was Fechner, whom Wundt, among others, has called one of the founders of experimental psychology! And this was Wundt who, as a matter of fact, did found a laboratory, and who proceeded to spend an entire lifetime in opening up a field of research which extends wider and wider with each new discovery! Wundt saw further than Fechner and, in 1879, he set aside for the first time, a small room to be devoted wholly to the experimental study of mental life.

This event, the founding of an experimental laboratory, we may take as the birthday of experimental psychology. It was the outward sign of an achievement of thinking or of a state of mind, viz., the attainment of the sober conviction that the methods and points of view of modern research could be applied to the study of the behavior and to a study of the mental life of animals and particularly of human beings, just as they were being applied to all other natural objects and events. It is in this same sense that the appointment of Johannes Müller to a newly created chair of physiology at the University of Berlin (1832) is said to mark the birth of physiology as an independent science. In a similar way we are accustomed to mark the birth of organic chemistry as an independent discipline. In 1837 Liebig perfected a simple piece of apparatus (the combustion tube) which was destined to become the symbol of organic chemistry and thus we say that 1837 marks the birth of this branch of chemical research. This piece of apparatus was, therefore, a symbol of another achievement of human thinking. It meant that the fruitful methods and points of view of physics and of inorganic chemistry were in the process of being carried over into the study of the chemistry of living tissues and their products.

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[1] See Brett, G. S., *A History of Psychology*, 1921 (3 vols.).

The Founders of Experimental Psychology.—A science is not made, of course, merely by the vote of an academic senate. Neither is it made by the establishment of a chair or the invention of a piece of apparatus. These events are merely an objective record of what is going on in men's minds. The creation of a psychological laboratory did not mean, therefore, that a science of psychology had suddenly been called into being; this act was, rather, a way of crystallizing thought. It was a way of making psychology conscious of itself, conscious of the fact that it had a suitable experimental method, a subject matter to which experimental methods could be applied, and a supplementary science, viz., physiology or, strictly speaking, neurology, to which it could go for principles of explanation.

(*a*) The selection of a subject matter for psychology, that is, a definition of the kind of material with which the new science should work, and the selection of a point of view from which this material might be regarded, came from Wundt. Nearly a score of years before he opened the door of his little laboratory (*i.e.*, in 1862) he had written out his ideas on psychology as an experimental science.[1] We shall consider his definition of the subject matter of psychology and his selection of a point of view for psychology on pp. 49ff.

(*b*) Wundt also had ideas about the uses of experimental method in researches on mental facts and we owe to him a long life devoted to the extension and realization of these ideas; but the first actual experimental methods came from other sources. Pertinent illustrations of what an experimental psychology might do in a laboratory were derived, for the most part, from the new experimental sense-physiology begun by Johannes Müller, and brilliantly extended by a group of distinguished physiologists, among whom we shall mention only Helmholtz and Hering.[1]

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[1] Wundt, W., *Beiträge zur Theorie der Sinneswahrnehmungen*, 1862. (Contributions to a theory of sense perception.)

Almost simultaneously, similar motives to research in psychology came from what are known as the "psychophysical methods" as they were devised and elaborated by Weber and Fechner, the former an anatomist and physiologist, and the latter a physiologist and philosopher.[2] These experimental methods and their significance to an experimental psychology will be described briefly on pp. 59ff. The reader will also find, in the same pages, a short account of the accidental and interesting way in which the mistakes of an astronomer's assistant gave an impetus to the experimental study of psychological problems.

(*c*) Suggestions for a way of explaining or of accounting for facts in the new science came from a long line of speculators and experimenters who had been showing step by step throughout the centuries, first by casual observation and argument and then later by carefully controlled experimentation, that mental life or consciousness is intimately dependent upon the functions of the nervous system and of organs related to it. A partial list of some of the discoveries which were of importance to psychology in its early days will be found on pp. 64ff., while a discussion of some of the problems raised by these discoveries will be found in Chapter IV.

Weber, Fechner, Helmholtz, and Wundt stand foremost among the founders of experimental psychology because they actually demonstrated by laboratory methods what could be done in the experimental study of certain phases of mental life and of behavior. Men had for centuries been *speculating* and arguing about mental life and about intelligence, but it had not occurred to many of them to *experiment* upon these matters. Each philosopher felt reasonably sure that he had a mind or an intellect, and he assumed (sometimes he was fully convinced) that anything which his intellect had reasoned out about its own nature or about the nature of another object must be right. Victory in all debatable matters went, then, to the man with the most profound arguments. There was a time when men attempted to settle questions in astronomy by advancing opinions and arguments or *reasons*, and of late other men have attempted to settle questions in biology, likewise by advancing *reasons*.

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[1] See, in particular, Helmholtz, H., *Handbuch der physiologischen Optik*, 1896, (first edition, 1859) and *Die Lehre von den Tonempfindungen*, 1896 (first edition, 1863). Hering, E., *Grundzüge der Lehre vom Lichtsinn*, 1905–1920 (first edition, 1874).

[2] See "Der Tastsinn und das Gemeingefühl" in Wagner's *Handwörterbuch der Physiologie*, iii, 2 (1846). Weber's work first appeared in Latin (*De Tactu*, 1832). Fechner, G. T., *Elemente der Psychophysik*, 1860.

In the 60's, 70's, and 80's of the last century, however, men began to think and to act differently about psychological problems. Instead of saying what *must* be so, or what *ought* to be so, they began to ask questions of nature and let nature answer the questions in her own way. Apparatus and methods were devised so that nature could answer the questions directed at her in a language that could be understood by men. This is what Weber, Fechner, Helmholtz, and Wundt were doing. It is for this reason that we call them the founders of experimental psychology, and of the four, history names Wundt, in particular, because he, above all the others, became an experimental psychologist.

The First Problems of Psychology.—Upon the face of it, the general problem and the general point of view of an experimental psychology seem fairly simple to us now. Men must bring animals and human beings into a suitable laboratory and institute experiments upon their several forms or types of intellectual talent. But when Wundt began his work this undertaking was not so simple. Of the many difficulties and misunderstandings which he faced we describe in greater detail only four, viz., (*a*) the fundamental conflict between two theories of knowledge, that is, two ways of proceeding in order to gain dependable information about ourselves and about nature, (*b*) the lack of an adequate definition of intellectual talent or, as language then went, of *mental life*, (*c*) the uncertainty as to the kind of methods and experiments that would be useful to the new science, and (*d*) the confusion as to how one should explain mental phenomena and as to where one should go for adequate explanatory principles.

The Relation of Theories of Knowledge to an Experimental Psychology

Men have never been able to agree about their own talents for gaining knowledge. Neither have they been able to agree as to which talents they should use in gaining knowledge about themselves and which they should use in gaining knowledge about the natural world in which they live. We have eyes with which to see and brains with which to think; but no one has been able to say with any confidence which means of knowledge should be used when we turn psychologists.[1]

Or let us approach the problem of this section in another way. The preceding paragraphs have taken it for granted and the following paragraphs will attempt to show that the first experimental psychology meant the application of the principles and the methods of the physical sciences to the study of mental life. Now we may ask, What are these principles and what are these methods? and, How do they differ from those that prevailed before science became a common heritage?

The answer to these questions is of great importance to the student of psychology for it will aid him in understanding what was implied in the point of view which Wundt adopted, and what was implied in the physical and physiological methods which Weber, Fechner, Helmholtz, and Wundt brought over into the psychological laboratory. But an answer to this question will help in another way, for it will permit us to go deeper than we could otherwise go into the quarrels that arose then, and arise now, between psychologists.

Rationalism.—A vague suggestion as to the theory of knowledge (hence, the philosophy) which lies behind the methods and the principles of the natural sciences, was given toward the end of the section just above. We said there that philosophers had been arguing for centuries about psychological matters and that, implied in most of these arguments, was the assumption that the royal road to truth runs, for the most of its distance, through the domain of logic. Given Rodin's "The Thinker,"—that is, given the power to think, to rationalize, to draw inferences, and to make deductions,—and the book of knowledge will be complete, so it is alleged, whenever man has had time enough to come to the end of his deliberations, whenever "The Thinker" has breathed a concluding sigh of relief.

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[1] Read Whitehead, A. N., *Science and the Modern World*, 1925; Burtt, E. A., *The Metaphysical Foundations of Physics*, 1925.

This type of psychologizing (every other science has gone through the same stage) is known as rational psychology. Rational psychology is merely the reflection of a great movement in philosophy which prevailed for centuries (from the 5th B. C. to the 16th A. D.) and which placed a premium from first to last upon the almighty power of *reason*.

Empiricism.—The theory of knowledge implied by science is of a wholly different order. In science one depends first upon what one can see and hear and feel. Science begins with experience and it attempts to stay within the limits imposed by experience. The word which has come to us out of the past to describe the philosophy of science is empiricism. Rationalism and empiricism are, then, two opposed ways of searching for dependable knowledge about ourselves and about the world in which we live. The rationalist *thinks* things through, the empiricist *sees* things through. The rationalist intuitively knows what is true and argues from this base to a complete picture of the world; the empiricist watches, observes, experiments, tinkers here and there with objects and events, and writes down what happens. He becomes rationalistic only long enough to order his facts, derive inferences from them, and thus prepare the way for further experiments and inquiries.

We are now in a position to point out a great difference between the rational and the empirical modes of approach to a problem. *Anything may be thought about;* but only *natural objects and events*, or physical objects and events, or such objects and events as lend themselves to physical control and measurement, can be tinkered with, *i.e., can be experimented upon.*

The first real problem which the founders of experimental psychology had to face, then, was this: Are psychological facts of such a nature that they can only be thought about, reasoned about? Or are they of such a nature that they can be tinkered with, experimented upon? If the reader can get this distinction firmly in mind it will help him to understand the great difference between the old soul psychologies and the more modern experimental psychologies. He will see, too, why it is that so much in psychology hinges upon the point of view from which one regards the materials of the science. If mental life can be approached only by intuition, if intellectual talent can be deduced only by logic, it becomes obvious that psychology and physical science can have little intercourse with one another; but if a way is found to experiment upon psychological facts, the future of an experimental psychology is as bright as the future of any laboratory science.

Psychology and " The Age of Science."—Wundt was of the opinion that men could formulate and carry out plans for research in psychology and we shall see in a moment how he went about it to prove his point; but there is still something that ought to be said about science before we shall see the first days of psychology in their true light. In the 60's, 70's, and 80's of the last century, science, and especially physical and physiological science, was at its height in Germany and elsewhere upon the Continent. Physics and physiology had come to their grandiose days. Helmholtz's acceptance of the chair of physics at the University of Berlin in 1871 put him at the head of what has been called a "Temple of Physical Science." A famous physiologist was building, at the University of Leipzig, a "physiological theater" in which could be demonstrated every conceivable type of physiological research. There were models in heroic size of all types of bodily organs and there were operating tables for any creature from a horse to an earthworm. A maze of electrical connections and a system of replaceable charts made this theater a symbol of "the German science." Over the door of another laboratory (Kolbe's chemistry laboratory) was to be found this inscription: "God made the world according to number, weight, and measure."

This was the atmosphere in which experimental psychology was born. The physical and the physiological sciences were being dramatized and they were making their influence felt in every phase of continental culture. Experimental psychology made its first bow upon this stage.

Perhaps we can see even more clearly now than we could a moment ago the contrast between the rational and the empirical methods in psychology. If psychological facts can only be thought about, psychology could have little commerce with this materialistic, mathematical, natural science of the 60's, 70's, and 80's. If, however, psychological facts can be tinkered with and if, moreover, they are to be tinkered with as one tinkers with a bit of muscle, a cell, a piece of protoplasm, and the like, psychology not only will have intimate commerce with physics and physiology but it will be a physically and physiologically minded science as well.

At the very beginning, then, of experimental psychology we find cause for disagreement. There were those who felt that psychology was above science, that psychology had to do with facts that were not amenable to experimental procedures; and on the contrary there were those who, like Wundt, saw the future of psychology only in laboratories. With these things in mind let us now consider, in turn, the subject matter of the new experimental psychology, the experimental methods of the new science, and the principles of explanation which were to be derived from within and from without the science.

The Subject Matter of the New Experimental Psychology

Reason is not a thing in the sense in which clouds and stones and animals are things. Consequently reason is not something that can be experimented upon and tinkered with as one would experiment upon or tinker with a piece of stone. Human beings, however, who are in the act of reasoning, that is, human beings who are in the act of solving a problem, can be experimented upon. Reason can be reasoned about; but it is only reasoning, the process, the performance, the act, that can be experimented upon. This is what we mean to say when we affirm that the soul can be thought about, that it can be reasoned about, that the arguments pro and con can be weighed, but that the soul cannot be experimented upon. We have no technique for this kind of experimentation. Seeing, hearing, resolving, and feeling, on the contrary, can be experimented upon. In other words, the possibility of erecting a science often depends upon the discovery of a point of view with respect to which the use of an experiment is not only possible but plausible. It is now our task to see how Wundt found a point of view that would fulfill these requirements.

Five Minutes of Human Experience.—The whistle has just blown, the football rises in a beautiful kick-off toward our own goal, it is caught, there is a rush of men, a hard tackle, and the game is on. We, the spectators, *see* the field stretched out before us, with its holiday array of colors in many hues, many degrees of richness, many different shades. We *hear* sounds of every description, the thundering applause from the opposing bleachers, melodious anthems from the bands, the noisy stamping of feet, and the piercing shriek of whistles. We have probably *forgotten,* in the excitement of an attempted forward pass, the *taste* of peanuts or of milk chocolate in our mouths, the crisp *odor* of a late Fall day, the aroma of a good cigar near by, the sweet perfume of our neighbor's bouquet of flowers. In spite of the warm, itchy wool on our backs we *feel* the penetrating chill of November winds. The excitement of the game has upset our digestive systems and we actually *feel* a sinking in the pit of the stomach or widespread organic thrills of relief, as the fortunes of the game turn now one way and then another. For a moment we are virtually overwhelmed with *joy* and *anticipa-*

tion only a moment later to be cast down in utter *dismay* and perhaps forlorn *disappointment.* We *throw* our arms, we *grip* our seats, we *shout,* we *arise* with a thrill of expectation only to *sink back* in foreboding or in genuine fear. In spite of our excitement we are *amused* by the expressive antics of our neighbors, their earnestness and concern.

A lull comes in the game; someone is hurt and we are *sorry;* we pass a moment in *reflecting* upon the meaning of it all. At another time the quarter ends and in the short period of rest we seek to *anticipate* the probable outcome. We *see* in our mind's eye the celebration that will follow a victory and the quiet somberness that will come with defeat. We *recall* our miserable feelings after the last game lost or enlarge imaginatively upon the fruits of victory. We *deliberate* for a moment on the splendid fight the boys are making and suddenly find ourselves even philosophically inclined, *concluding* that the athletic field, in spite of the danger of injury and abuse, is a place where men may *learn* all they ever will learn about the real meaning of integrity of spirit. But even as we *deliberate* upon some of the larger aspects of physical competition the whistle blows and we are again caught up in a veritable flood of experience, in a flood of sights, sounds, emotions, anticipations, memories, and actions almost without number.

Definition of " Mental Life."—Implied in the above description are the plain facts of seeing, hearing, acting, in short, the plain fact that the spectators in the stands have been enjoying some sort of experience of the objects and events about them. Each one says: I see, hear, taste, touch, and feel objects and events, I reflect and deliberate about them, I remember them, and imagine them; in short, I have, or undergo, or *am* experiences. In this account, *experience* does not mean a long life spent amid many changing scenes. It means that men are, by their own report, at every moment of their waking lives, and sometimes in their dream lives, aware of something. Now we must have a name or a word which we can use when we wish to think, at one and the same moment, of these varied and ever-changing processes of seeing, hearing, touching, thinking, remembering, resolving, hoping, and fearing. This word is *mind.* The phrase "mental life" is better. William James spoke of the "stream of consciousness." In the rest of this chapter, we shall speak of the *stream of experience.* Later on we shall learn of men who speak of *the stream of behavior.*

Seeing, hearing, touching, tasting, and smelling are called perceptions. To these classical divisions of perception the new science has added kinæsthetic and organic perceptions, that is, perceptions arising from the action of the muscles and joints (kinæsthetic) and perceptions arising from the internal organs (organic). Then there are the simple feelings, moods, emotions, passions and temperaments which are said to belong to the affective side of mind. Memory, imagination, judgment, thinking, etc., were called the "higher mental processes." Finally, the experiences which arise when a person is acting, that is, the experiences characterizing simple impulsive movements, choice, will, resolves, and the like, make up the active side of mind. A *mind*, we may repeat, is said to be a whole lifetime series of just such events.

Psychology: The Science of Mental Life.—The facts are plain enough. We have experiences, the stream of experience runs on, and we are agreed that we may call the whole stream *a mind* or that we may speak of any part of it as mental life. But now what shall be our procedure?

In the history of psychology, prior to the middle of the last century, it was customary to forsake consciousness, the stream of experience itself, and go to a something which had or contained the experiences. This something was usually the soul. Sometimes it was a "thinking principle." It was the soul that looked out of the eyes and saw, the soul which listened attentively behind the physical ear, a soul which deliberated, a "thinking principle" which reasoned and solved problems.

This was a favorite trick of the rational psychology. It often forsook what was actually given in experience and chose something behind experience, to think about. Empirical psychology, on the other hand, meant to take experience for its own sake. It meant to take seeing, hearing, feeling, deliberating, choosing, and resolving, not as activities of a soul, but as events in their own right, worthy of examination because of their own intrinsic merits.

A whole section of the next chapter will be devoted to the details of the psychology which was worked out by Wundt and some of his students; but it will be helpful to the reader if we spend a moment or two now on a sketch of what was actually done in order to create a "science of mental life." *A mind*, we say over again, is a whole lifetime series of experiences. The scientific problem is to take mind, item by item, experience by experience, render descriptions of each item, find simpler items wherever possible, state the laws and principles which bind items together, and do what other tasks the conditions of the experiment seem to suggest. There is nothing difficult or weird about this. Conditions are arranged in a laboratory so that the same perception, or the same memory, or the same choice may be experienced over and over again until nothing more can be said about the item under investigation.

You are reading this book. It is one thing to dismiss the whole matter by saying that books are made to be read, that you have a soul which chooses at this moment to read, and that, therefore, the reading gets done. It is another thing to know what the physiologist has to say about the structure of your eye, about the lens, the retina, the point of clearest vision (fovea) and its relation to clear vision, the optic nerve, the relation of this nerve to the brain, and the relation of the brain to the muscles that move your eye from point to point along the page. It is still another thing to hear what the psychologist has to say about the size of type which you can read most readily, the amount of spacing that ought to exist between lines, the proper length of lines, the proper degree of illumination in relation to the paper used in the book, the effect of various drugs upon the reading process, the changes that should be made in reading distance, in artificial lenses, and the like, in order to assure you that you are reading efficiently. These are the facts which one gathers when one has taken reading as a process having some scientific merit of its own. Such facts did not and do not come out of rational psychologies.

The transition from rational to empirical psychology was of several centuries' duration; but the decisive and productive step in the period of transition was taken by Wundt. After Wundt psychology was a science of mental life, a science of experience, instead of remaining a system of logically deduced principles about the soul. Wundt distinguished the problems of a *science* and a *theology*. According to Wundt, experiences were worthy of being taken as they were found, at their face value, and described as one would describe any other object or series of objects, that is, by rendering a descriptive report of them under known and controlled conditions. By this token, then, mind came to designate the stream of experience instead of an agent, or power, or force, or collection of special faculties which might lie behind experience.

"Inner" and "Outer" Experience.—Since time immemorial thinking has appeared more mental, more psychological, than perception. Thinking goes on in our own heads, so the common belief runs, while perception seems to be related to the head only because our eyes, ears, tongue, and nose are in the head. Perception, whether of a football game, a toasted sandwich, or a jazz orchestra, is somehow concerned with objects outside of our heads. In the illustration given above, each spectator may be thought of as seeing the same field and the same plays, hearing the same bands, etc., but reflections about the meaning of it all, the memories, the many changing moods and emotions! They belong to each person and to him alone. They, like our dreams or a toothache, or like our deepest deliberations, are intimately a part of an inner mental life. These facts were so obvious to the ancients that they talked about two souls and sometimes of three souls instead of one. There was, for example, the rational soul of the most refined soul substance, and then there might be a soul of coarser stuff to which could be attributed the powers of perception. And at least one of the ancients (Aristotle) spoke of still another and coarser soul, the vegetative soul, which exercised control over the vegetative functions of man.

The student will grasp the issue that is being raised in this section if he will look at his book and ask himself whether he is seeing the book itself or whether he has only sensations which somehow *mean* book. He may say, "Why, yes, it is a real book, not merely *my* sensations, because I can feel with my hands that the book is there." But touch too is a matter of having sensations! If one gives himself over to reflections of this kind one will soon find that the objects which we perceive are not so real after all, not any more real than the objects we dream of or the objects we remember or imagine. In using this illustration the student should not be tempted to run off into a fruitless and endless series of speculations. We mean only to make it clear that whether we are seeing with the eyes of the body or whether we are seeing with the "mind's eye" we are limited to our own experience, we are dependent upon sensations for our information.

We sit down to a hearty meal. The objects on the table are seen, the conversation is heard, the food is tasted. Wundt urged that in these perceptions mental processes of variable sorts are used (see pp. 83ff.) just as they are when we sit down the next day to recall the feast of yesterday. In the perception of the table, certain objects are seen and heard and tasted; but in the memory also certain objects are seen and heard and tasted. The difference is that in the perception such mental processes as sensations are used while in the memory such mental processes as images are used. The older psychologists had believed that objects remembered or objects thought about must be mental objects, while objects seen or objects heard must be physical objects. The point is that all that we can know of any kind of object is dependent upon some sort of mental process. At the dinner table the things that make up our experience are not steaks and potatoes and apples and pieces of pie; they are sensations, and a sensation is just as mental or just as psychological as a memory or a thought process.[1]

This belief that there is a *more* or *less* psychological, an inner and an outer mental life, a subjective and an objective type of experience was another obstacle, so Wundt thought, in the way of an experimental psychology. He set about it, therefore, to change this whole mode of viewing the materials of psychology. He saw clearly that there could be nothing that was more or less mental, more or less psychological. All experience must be mental, must be matter for psychology, or it must not be at all mental, that is, it must be material for some other science. There could be no middle ground, no event or process that was half mental and half physical or physiological.

Wundt changed the distinction between inner and outer to a distinction between experience as dependent upon an experiencing individual (immediate experience) and experience as independent of the experiencing individual (mediate experience). It was Wundt's idea that when we regard experience or mental life from the point of view of the experiencing individual, that is, when we regard seeing, hearing, or remembering as processes which are going on for some one, we have the point of view which the psychologist should take; but when we regard experience as independent of the experiencing individual, as implying the existence of objects and events which *outlast the experiencing of them*, then and only then do we have the materials of the physical or natural sciences.

Let us make this distinction a little plainer through the use of one or two illustrations. The colored electric discharges which pass through a Geissler tube while a physicist experiments on gases at low pressure may be taken as the physicist means to take them, viz., as physical events which go on independently of our experience of them. In so far, the colored discharges belong to the world of physics and chemistry. But they may also be taken as the psychologist means to take them, viz., as events going on or occupying a place in the stream of consciousness of some individual. For the physicist the electric discharge may be something independent of him, but it may also be an event in his experience, something of which he is conscious, something which will cease to exist for him if he should happen to take a nap.

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[1] The reader may have a little difficulty at this point; but if he will be patient and follow through the next paragraph and then re-read all that is being said here after he has read what will be said in the next chapter, the whole matter will become much clearer.

In this way Wundt meant to arrive at a definition not only of the subject matter of psychology but at a definition of the subject matter of the other sciences as well. It does not matter to us at this moment whether Wundt was right or not. As a matter of fact, other men found all kinds of difficulties with the position which Wundt had taken. The important point is that this definition put psychology upon the same level with the other sciences and made it possible to experiment upon immediate experience, *i.e.*, upon the mental life of an individual without troubling oneself over questions as to the existence or non-existence of the soul or conundrums as to the nature of the soul. Men had experiences, this was the point, and the next step in the establishment of an experimental psychology was to make experiments upon experiences.

The Naturalness of Man.—The student should not fail to catch the full significance of this "next step." By long tradition the soul or the mind had been known as a free agent, a being of another world, a substance independent of any of the laws or principles that might seem to concern the natural world. The good man who refused to look through Galileo's telescope for fear he would see the irregularity of the surface of the moon is no more of a pathetic figure in the history of science than another good man who refused to look at a lighted figure in a window for fear he would see an afterimage.

The program of the new experimental psychology meant that the conditions of mental life, both the conditions which determine its appearance and the conditions which regulate the sequence of its several parts, resemble the conditions under which other natural events arise, and the conditions which determine the sequences into which these events fall. This was a momentous event in the history of science. It meant, by implication at least, that mental life in its varied aspects must somehow be part and parcel of a natural order of things. Physiology and biology had already shown that man was a natural creature living in a natural world; but St. Augustine's *City of God* and much of the subsequent scholastic philosophy had made it appear that man's true home was not in this world, that his concerns were with the world to come, that his body was the temporary residence of a Being whose ambitions were wholly at odds with the Here and Now; but physiology and biology had shown that man was a natural creature living in a natural world. Nineteenth-century science made it appear more and more that man was now in his true home, that just as his body was of the stuff that stars are made of, so his behavior, his intellectual life, was of the stuff that nerves are made of. The full significance of the naturalness of man has not yet been stated. The present century, it is true, has realized some of the implications of the fact that man's true home and his true concerns are suggested by biology rather than by theology; but there is still much to be thought of before we shall come to the end of this mode of thinking.

"Mind" and "Mental Life."—It will be helpful in all that follows if, at this point, we make a sharp (although arbitrary) distinction between what we shall mean by "mental life" and what we shall mean by "The Mind." No one appears seriously to doubt the fact that some sort of mental life acts as an escort to that process of getting-on in an environment which we have made it the business of psychology to examine. Disagreement arises when men try to decide what difference the "escort" makes to the getting-on itself. It was implied in the last chapter that mental life made no difference, and this implication will be subjected to further inquiry throughout Chapter IV. In the traditional psychology, however, it was taken for granted that "mental life" did make a difference. Sometimes it was assumed that "mental life" was the sole agency in enabling organisms to get along in their environments. This was the "soul psychology".

In the pages that follow we shall attempt to use the phrase "mental life" or derivatives of it on all those occasions when we are thinking of mental life as equivalent to *experience* or as an escort in those processes of adjustment which enable living beings to get on in their respective environments. We shall use the phrase "The Mind" whenever we are paying homage to traditional concepts or whenever we are thinking of mental life as *an agency* or *power* accessory to or contributory to, the functional talents of the nervous system. The reader will have his attention drawn to this distinction again when, in Chapter IV, we seek to describe some of the talents which nervous systems are thought to possess.

Experimental Methods

An experiment may aim at two different marks. In the one case, we may assume that we can control at will a series of events which we may designate A and that we mean to see how another series of events, say B, will change as we cause A to vary. Thus we can control to some extent the surroundings of a human being. We may then institute experiments in order to see how variations in the surroundings will cause or occasion variations in the mental life and in the behavior of the subject.

In the other case, we use the experimental situation to cause or occasion the same event over and over again until we have been able to write out a complete description of the object or event under examination. Instead of changing the conditions in order to secure a change of behavior we attempt to preserve the original conditions in order to get a more faithful description of the same behavior.

These two uses of experiment have run to cross purposes in psychology ever since the foundation of the first laboratory. Wundt's first idea of an experimental psychology aimed at experimentation of the first type named above. It would be useful to know how human beings change their reactions (either muscular or mental) under changes in the stimulus pattern. But this program was soon submerged under that suggested by the second uses of experimentation. What psychology most needed, so it was alleged, was a faithful and complete description of the mental processes set up under any standardized experimental setting. Thus the Wundtian psychology came to be a descriptive psychology, and the way was left open to others to examine the shifting relations between mental life and behavior, on the one hand, and variations in the stimulating conditions, on the other. The reader should keep these things in mind as we now attempt to see how psychology acquired its experimental methods.

Methods of Sensory Physiology.—There is a certain difference between experimentation upon the digestive processes or upon the heart action of a living creature and experimentation upon the sense-organs, for the former can be prosecuted successfully without the subject of the experiment being conscious of all that is going on, while the latter always involves a psychological factor. The physiologist who experiments upon the fact of seeing, as did Helmholtz, relies constantly upon reports from the subject in the experiment as to what he did or did not see. Let us assume that we are trying to determine the limits of visibility for different colors upon the periphery of the retina. We ask a subject to fixate a given point and we then bring into the field of vision, say from the right, a disk of red paper. The subject of the experiment is asked to report when the red disk or when the redness of the disk becomes visible. By moving into the field of vision from all angles (or by moving outward) and by choosing different colors one may soon discover an enormous number of facts about the nature of color vision, facts which were not gained in the days when men said that it was a faculty or power of the soul to see.

From this illustration we can see how it was that physiology furnished a good many models of experimental procedure upon which psychology was to base a large part of its first work in the field of perception. As a matter of fact, there was little difference between the work of the early psychologists and the work of the sensory physiologists. What difference there was lay in the fact that the physiologists were using introspective reports of their subjects (see p. 85) in order to find out more about the structure and the functions of the sense organs, while the psychologists were using similar reports in order to gain faithful descriptions of the kinds of sensations aroused whenever sense organs were stimulated. Thus it came about that Johannes Müller, Weber, and Fechner discovered many of the facts about tactual perception, and Helmholtz, Hering, and Stumpf many of the facts about vision and hearing that now go into any standard textbook on psychology.

The Psychophysical Methods.—One morning as Fechner lay in bed pondering over the relation between mental life, on the one hand, and bodily events, upon the other, the idea came to him that variations in the intensity of a stimulus were always accompanied by correlative variations in the intensity of the experienced sensation. He set to work immediately to place this situation under experimental control and to see whether the observations could be expressed in the form of a law. During the course of his reflections over these things he fell upon similar work done by Weber. Weber, whom Wundt has called the father of experimental psychology, had no end in view save to find out what he could about correlative variations in stimulus and sensation. Fechner, on the contrary, meant to find a law which could be raised to a high level and become a mathematical symbol of the whole mind-body problem (see pp. 134f.).

Weber had already generalized his experiments to this extent. He found that the relation between two pressures, for example, that are occasioned by two weights, say of five and ten grams respectively, is identical with the relation between two pressures caused by two weights of fifty and one hundred grams respectively. We do not, then, perceive equal differences in intensity when equal changes are made in the intensity of the stimulus.

As Weber put it, "in comparing objects and observing the distinction between them, we perceive, not the difference between the objects, but the ratio of this difference to the magnitude of the objects compared."

Fechner was able to extend the experiments of Weber and to work out a mathematical formula which expressed the relationship even more decisively than did Weber's generalization. Fechner's mathematical formula ($S = c \log R$, where S stands for the intensity of the sensation, R for the stimulus, and c for a constant) meant that while the stimulus, say the sound from a tuning fork, increases in a geometrical progression (1, 4, 8, 16, ...), the intensity of the sensation increases arithmetically (1, 2, 3, 4, ...).

We are not here interested in the tremendous discussion which waged about this formula and neither can we consider in greater detail the significance of it. What is of importance to us is the method by which Weber and Fechner secured their results. Ways of controlling stimuli were taken over from current physics and physiology and involved the use of pieces of apparatus by means of which one could present to an observer precise units of energy in the form of light waves, sound waves, mechanical pressure, temperature, etc. The subject of the experiment reported which of two experienced sensations was the more intense or whether a second sensation was or was not just noticeably different from a first, or whether a third sensation could be placed intermediately between two terminal sensations, etc. These and other methods came to be known as the psychophysical methods. They were based, one and all, upon the proposition that changes in the intensity or other properties of a physical stimulus could be used as a way of measuring the intensity or the quality of some phase of perception.[1]

Fechner thought that he was literally measuring the mind. This was an alluring thought when we remember that the last half of the last century really believed that "God made the world according to number, weight, and measure." But we know now that Fechner was not measuring mind. He was measuring the limits of a man's ability to discriminate between different stimuli. He was measuring the ability of a man to make different reactions to slightly different stimuli. This is an entirely different story and one that reflects almost a complete change in the program of psychology. We shall return to this topic in the next chapter.

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[1] Read Titchener, E. B., *Experimental Psychology (Quantitative)*, 1915.

Reaction Time.—Suggestions for a third mode of experimentation in psychology came quite by accident from an astronomical observatory. An assistant in the Greenwich Observatory had lost his position because he reacted too slowly to the light of a star as it moved across the field of vision of his telescope. He was supposed to mark the instant when the star cut a little thread across his field of vision; but his records always showed a little deviation from those expected, and from those which the head of the observatory obtained. This was the event which brought the reaction time into psychology. The assistant was a slow reactor.

The question asked in the reaction time experiment is: How quickly may one respond to various stimuli? There had been a time when such a question would have been laughed at. When Helmholtz discovered that the delay in reacting to a stimulus was due, in part, to the time that it takes for a state of excitation to find its way from a sense organ through the nervous system to the appropriate muscles, his father grieved that his son could be so led astray by the deceitfulness of experimental methods. But Helmholtz was right, and here again psychology bowed in recognition of physics and of physiology, for these sciences had already found instruments accurate enough to measure time intervals of the order of thousandths of a second, these being the values which are suitable in the study of nerve conduction, muscular contraction, and general problems of reaction.

Helmholtz's father could grieve over the heresy of his son because it was inconceivable that The Mind should have to take any time whatsoever in causing the body to react to a stimulus. Matters were made so much the worse when it was discovered that a choice reaction took still longer periods, even in spite of the attempt of the reactor to make his choice instantaneously. We can see why it was, then, that the reaction time experiments made a profound impression during the decades here in review, and why it was that the reaction time experiment rather than the psychophysical measurement became the foundation stone of all the modern reaction psychologies. The reactions of living creatures to controlled experimental situations was soon to give form and substance to psychology; the attempted measurement of sensation intensities gave it a brilliant chapter in technique but a dismal chapter in psychological point of view.

Principles of Explanation in the New Science

At the beginning of the last section we drew a distinction between experiments which repeatedly set up an event for description and experiments which bring out the causal relations between events. We must now examine this distinction a little more closely and we must describe more fully what is meant in modern science by the word cause.

Causes vs. Conditions.—Men used to search for the literal cause of an event, that is, the agency or the power which produced or brought about an event. We ask the question, "What makes men think?" and the classical answer was, "Men think because they are possessed of a thinking principle." Likewise one might ask for the causes of rain. The classical answer might have been, "It rains because there is in nature a rain-making principle." After scientific modes of thinking began to make themselves felt, men lost sight of such "principles"; but they did not lose sight immediately of the kind of logic which went along with the "principles." Suppose we are studying the causes of rainfall. We consider how bodies of air having different temperatures move into one another. We show how vapor tends to gather about small particles of dust. We measure points of condensation and the like, and at the end of our questioning we have a fairly good list of the factors that seem to bear upon rainfall. It is obvious, however, that each of the factors we have named is one of the conditions which favor precipitation, and not a cause in the classical sense of the word. Dust is the cause of rain in the sense that dust particles aid condensation. The sun is a cause of rain in the sense that it vaporizes water and allows the air to become more or less filled with molecules of water. A change in temperature causes rain because the process of condensation is thereby accelerated. Each of these factors is a cause of rain only because each provides one of the essential conditions that must be present before rain can fall. Modern science searches for the *relevant conditions* of an event rather than for the cause of an event. It is assumed that the natural world is characterized by the action of a large number of interrelated processes and the search for *the* cause of an event is, therefore, a meaningless search.

We may now apply this mode of thinking to psychological problems. The old psychology was not only a rational psychology but it was an explanatory psychology as well. It was explanatory in the sense that all mental phenomena were referred back to a soul. An explanatory psychology of this kind might be helpful to theologians and to metaphysicians, but it was of little aid to medical men, to teachers, and to such others as were searching for a way of understanding normal and abnormal behavior and for a way of correcting and controlling behavior. Medical men, for example, could do little practical good against diseases caused by souls (or demons), vital principles, and other unnatural or occult agencies. Moreover, a name does not explain anything. A name is not a useful instrument unless it represents or stands for an experimental mode of approach, unless it invites one on to further constructive thinking.

One may ask two fundamental questions in psychology, viz., What are the conditions under which various items of mental life are made to appear? and What are the conditions which favor one train of items rather than another? Of these two questions psychologists have been mostly concerned with the second; the first does not have to be answered before psychological research is put under way. We look at a red sheet of paper and experience the sensation of redness. The redness is an item in our stream of experience but we do not have to know how sheets of paper or nervous systems produce or occasion redness before we can take redness as an item and render a description of it. Matters are a little different, however, when we consider the ways in which the items of the whole stream of experience follow one another or are grouped into patterns.

In the case of perceptions the answer to this second question is relatively simple (as simple as such answers can be). The patterning of items in the stream of experience is conditioned by the patterning of the items which make up the stimulus. If a series of sounds is presented to an observer, he will hear a series of sounds, and not a chord. The automobilist sees an endless series of landscapes, the series being conditioned by the countryside, not by factors internal to his own body. The facts are not so simple, however, when memories and thought processes are under consideration. There is no simple way to account for the order or for the arrangement of the mental processes appearing in a memory or in an act of deliberation. At Wundt's time, however, and ever since his time, it has become more and more obvious that one must go to the nervous system for the relevant conditions of mental life. Men did not always know this and it will be instructive to name a half dozen or so of the events which led the thinkers of a generation ago to this conviction.

(*a*) It was Gall and Spurzheim who, with their doctrine of cranioscopy (phrenology), introduced the problem of mind-body relationship into modern science. Descartes had introduced the problem into philosophy two centuries earlier, but it was the experimental, not the philosophical, facts that were to become most significant. Phrenology meant that each of the major intellectual traits of a man could be associated with some definite area of the brain, the activity of which was responsible for the trait in question. Gall's method was highly empirical. When he found men with distinctive skull features (caused, so he believed, by excessive growth of the brain tissues beneath) and who, at the same time, displayed predominating intellectual traits, the areas were mapped and an attempt made to generalize the results. Unscientific as it was, Gall's method served to focus the attention of experimenters upon the mind-body problem (see pp. 134ff.).

(*b*) Between 1822 and 1824 Flourens showed by a series of skillful operations that the functions of equilibration or of balance stood in a one-to-one relation with specific portions of the brain and notably of the cerebellum.

(*c*) In 1861 Broca showed that loss of power of speech accompanied the destruction of the hinter part of one of the convolutions (third frontal) of the left hemisphere of the brain. Shortly thereafter, following the use of electricity as a means of stimulating exposed areas of the brain it was found possible (by Fritsch and Hitzig, Ferrier, and others) to map out those areas on the surface of the brain which appeared to be more intimately related to distinct types of muscular movement than were other areas. The final result was a picture of the brain which revealed not only distinct areas for precise functions, but many coördinating or associating areas tying the whole brain together into a unique and functional whole which could fulfill its office as the servant or the instrument of intellectual talent.

(*d*) In 1811 Sir Charles Bell published a paper on *An Idea of a New Anatomy of the Brain*, in which he laid the foundations for the discovery of the reflex arc. The reflex arc, as we shall find (p. 199), is a simple organization of nervous elements with the power to conduct a nervous excitation from a sense organ to some muscle. The actual discovery of the reflex arc was made by Hall (1832) when he found that decapitated newts could still react to certain stimuli. Hall assumed, and we now know that he was correct, that the spinal cord could take care of simple reflexes of this kind. This discovery and the many which followed it laid the foundation for a theory of functional (smallest working) units of the nervous system. The theory was tremendously aided by the discoveries of Golgi, W. His, and Ramon y Cajal (1889) which showed that nervous tissue was in reality composed of an enormous number of small cells with interconnecting fibrils, the whole admirably adapted to the conducting and integrating functions allotted to it by the theories. That is, the brain could be thought of no longer as a device for cooling the blood. It had to be thought of as a great system of conductors of nervous impulses standing between the sense organs, on the one hand, and the muscles, on the other. These discoveries of the anatomists opened an alluring picture of the relations between items of mental life and distinctive nerve pathways and groups of nerve pathways in the brain.

(*e*) In 1832 Müller announced a famous doctrine concerning the relation of sense organs and sensory nerve fibers to the qualities of sensation. This doctrine, called the doctrine of specific energies, meant that the qualities of sensation are dependent upon the properties of the sense organs rather than upon properties to be found in stimuli. For example, no matter how the optic nerve in the eye is stimulated, the result is always some form of visual sensation. Light may be thrown upon the retina, it may be stimulated electrically, or mechanically, but the result is always a visual sensation, not a pressure or a pain or some other quality which might be produced when these same stimuli are applied to some other part of the body. The same facts hold true of audition. Excitation of the auditory nerve issues only in auditory sensations no matter whether the nerve be excited by sound waves, or electrically or mechanically. Here was another place where the quality of a mental event appeared to be fundamentally related to the nature of a bodily organ.

(*f*) Müller's doctrine of specific energies has a parallel in

Lotze's doctrine of local signs. If you will close your eyes and ask your neighbor to touch you with the point of his pencil somewhere upon the back of your hand, or upon the back of your neck or upon the face, you will observe that you feel a pressure and that you also *locate* the pressure. It is a pressure at *some one place.* Lotze, a famous philosopher of Fechner's time, explained this localization of a pressure upon the body by saying that each sense organ in the skin has, so to speak, a label on it, a sign upon it which gives it a place with respect to other pressures.

(*g*) Müller's doctrine of specific energies was expanded into a theory of vision and a theory of hearing by Helmholtz in that he assumed not only the generalized doctrine but a very specialized doctrine as well. In his theory of vision, for example, Helmholtz assumed not only that visual sensations in general owed their qualities to the nature of the optic nerve, but that each specific visual quality (each hue or color) depended upon some specific type of receptor in the retina. Some of the cells in the retina were said to occasion sensations of redness while others were said to occasion sensations of blueness, and so on. The same method was used in devising a theory of hearing. Each single tone in the whole series from the lowest bass to the highest treble was assigned to one or more vibrating fibrils or membranes in the inner ear (basilar membrane). Thus again the intimate relationship between the quality of sensation and the organs of the body was accentuated.

(*h*) In 1829 Weber found that two impressions upon the skin will be distinguished as two only if separated from each other by a sufficiently large space. This distance was found to be different for different parts of the body, a fact which was later explained by the discovery that judgments of one object or of two are a function of the distribution of sense organs embedded in the skin.

The Doctrine of Psychophysical Parallelism.—If now we realize that there were multiplied hundreds of discoveries like these and if we consider all of them in conjunction with the discoveries of Weber, Fechner, and Helmholtz already named, we can appreciate why it was that the first experimental psychology was called a physiological psychology, a psychology without a soul. Psychology went to physics and to physiology for its apparatus, many of its first problems were problems in sensory physiology, and all of its methods were taken over bodily or were adapted from physiological laboratories.

But this is not the most significant fact. Physiological facts were laid hold of to explain psychological facts. We must be perfectly clear as to what this means. It was said above (p. 64) that explanation means describing the conditions under which an event may take place. Very few men have said that the brain produces or causes mental events, but a great many have said that it furnishes some (probably all) of the essential conditions under which mental events may occur. If there were no brains we suppose that there would be no mental life, at least among the forms of life with which we are familiar.

In order to use physiological and nervous events in a suitable way it is necessary to have some pragmatic scheme of the relationship between the series of mental events and the series of nervous events. It is necessary, in other words, to generalize on all the facts suggested by those listed above, and arrive at a useful inference that will satisfy the experimental program to be laid down. Wundt felt that the psychologist was under no obligation to arrive at a final solution of the mind-body problem before he could proceed with his experiments. He said he would assume a perfect parallelism between the two orders of event, *i.e.*, between those in physiology (or neurology) and those in mental life and be sure, therefore, that whenever he passed from one science to the other, although his language would be different, the order of events would be the same. The fact that we control physiological and physical events in order to control mental events need not trouble us, he said, for the two orders always run absolutely parallel with one another. Controlling the experimental setting and controlling the organism,—the subject who is reporting his experiences,—means controlling the experiences themselves, if the parallelism between the mental series and the bodily series is a *thoroughgoing* parallelism.

The Nature of Psychological Description.—The fact which is asserted in the doctrine of psychophysical parallelism is simple enough. Here is a whole stream of items which is called the stream of experience. There is a whole stream of events in the brain which is called the stream of neurological conditions. Between these two streams there is assumed to be perfect parallelism. But it is not the alleged fact of parallelism that was of most interest and significance for the future history of psychology. The cardinal features of this doctrine lie in two or three implications about mental life. One of these brings us to the differences between a purely descriptive psychology *vs.* a dynamic psychology, and the other brings to us the supposed "structure of the mind." We shall consider descriptive psychology now and the "structure of the mind" in the next paragraph. The psychology called Dynamic will appear on p. 111.

Let us assume that we have before us a series of items, say the items that would be concerned in the solution of a problem. We are thinking, and the items that make up our stream of thought follow one another, not nillywilly, but in a useful and productive sequence. We wish to explain the sequence. We wish to know why the items appear in one certain order rather than another. We ask this question in the same way that we might ask why the leaves follow one another as they do across a meadow on a late fall day. Do the leaves chase one another because each has a certain choice about the matter, a certain capacity to align itself with respect to the others, or do they chase one another because of the eddies in the wind, the unevennesses of the ground, and the like? Perhaps we are not interested at all in why they chase one another. We note merely the fact that they do, and proceed with a minute description of each leaf in the series.

This represents in a rough way the position of the descriptive psychologist who uses the doctrine of psychophysical parallelism as a substitute for a mode of explanation. The sequence of items in the stream of experience is noted, the ordering or the arrangement is alleged to be due to other factors than those intrinsic to the items themselves, and each item is subjected to an exhaustive scrutiny. In other words, we may think of the items that compose the stream of experience as items that are simply present, items that stand before us because of other conditions and factors than those that may be intrinsic to their own being, or we may think of each item as something that reflects in its own being some sort of *intrinsic dynamic power*, some power of self-determination. That is, mental processes may imply a *stream* of consciousness because the propulsive force is outside of the thing propelled or they may imply self-propulsion. If mental processes themselves have power, if they themselves are effective agencies, then we have that mode of psychologizing which is known as dynamism (see p. 111). The outside power, on the other hand, may be thought of (*a*) as resident in the nervous system or (*b*) as resident in a soul or (*c*) as resident in a mental life which is more than and which stands behind the items being described (the theory of the subconscious, see Chapter XVII).

The first experimental psychologists chose to describe what they found in the stream of experience and to leave to the nervous system all that could not be found by a direct inspection of mental items. The sequence of mental items in the stream of mental life was not a sequence due to the activity of the items themselves, but it was due to the ordering and arrangement of processes in the nervous system just as the ordering or arrangement of a series of perceptions was due to the ordering and arrangement of the landscape, the melody, the banquet, or what not. A number of names were invented to describe these ordering or directing trends in the nervous system. We shall meet, on the following pages, such words and phrases as "determining tendency," "associative tendency," "problem-bearing tendencies," "set," "disposition," "attitude," and the like. All of these mean that the nervous system directs the course of mental events much as the bed of a stream directs the course of the stream. Not all of these "tendencies" were discovered during the early days of psychology, but that they were discovered at all is a reflection of the direction in which psychology was working. We shall come upon them again on (pp. 157ff.).

" The Structure of the Mind."—We assume that psychology is to be defined as the science of immediate experience. We have at our disposal, for examination, that whole series of mental items, a lifetime sequence of which we call a mind. The task is description. We arrange our experiments in such a way that we can produce one item of the whole stream an endless number of times. We examine this item until we are satisfied that we have said all there is to say about it. We pass on from item to item. We find similarities and dissimilarities between items. We find that all sensations of color are more like one another than they are like sensations of pressure. All odors are more like one another than they are like tones or noises. Thus we are able to classify our items. But we are able also to describe patterns, that is, groups of items that stand together in definite wholes or structures. We may speak, then, of the structure of the mind, of the ways in which items join with one another to make up the whole mental life with which description began.

In spite of the purely descriptive psychology which issued from the Wundtian laboratories, men were still thinking, even at the turn of the century, of "the workings of the mind." The most intriguing thing about bodies is not their structure but the way they work. Function, way of working, naturally goes before structure, way of being built. But descriptive science favors structure rather than function, and the phrase "structure of the mind" became, then, the symbol of a scientific psychology. A score of years ago "structuralism" was an easy way of designating the products of the Wundtian laboratories. It was a sort of insignia which showed that psychology had come into sciencehood.

We are now in a position to see more or less clearly what the program of the new science was. The attempt was to be made to render a complete description, part by part, item by item, of that magnificent structure which could be called a human mind. The results of this program will appear at the beginning of the next chapter; we must now turn to a brief review of some of the problems which the new psychology was not able to attack.

THE SHORTCOMINGS OF PHYSIOLOGICAL PSYCHOLOGY

We should hardly expect that any one man at a single moment and at a single stroke could free himself from the whole history of philosophy, align himself with the whole history of science, and divine the course of future discovery so that the product of his thinking, an experimental psychology, should be adequate to the whole field of interest of psychology and adequate to the manifold relations which the new science would have to sustain to related sciences. We could not even expect that a whole lifetime would be adequate to so Herculean a task. It is no discredit to Wundt, therefore, to realize now that his program and the program of experimental psychology at large had certain limitations. Wundt's point of view was admirably adapted to treat, in a certain way, the problems of perception in all forms, but it did not lend itself readily to certain other problems. It will be illuminating to ask about some of these problems, but whatever they are or whatever the historian may say about Wundt it will always be clear that he gave to psychology a scientific standing and the impulse to erect laboratories. This is what counted most when the science was young.

Problems of Learning and Memory.—Learning means acquiring a skill and memory means reliving a former experience. In either case the problem of a descriptive science would consist of an account of the mental processes occasioned either by a skill or by the revival of an experience. But an analytical description of the experiences which characterize the process of learning, or a description of the imaginal elements that constitute a remembered event, tell nothing at all of the most economical methods by which a memory or a skill may be acquired. The first time that one drives an automobile mental life is a confused mass of experiences occasioned by the instructions of the teacher, the need of changing gears, using the brake, observing traffic, handling the wheel, and so on. If one were to render a descriptive account of the first five minutes of such an experience one would have material enough and to spare. Visual perceptions of the street corner, the coming automobile, the child darting into the street, auditory perceptions of the warnings of the "back seat driver," tactual perceptions and muscular perceptions of the clutch, the wheel, the brake, and so on would have to be disentangled, each examined for constituent parts, and the parts subjected to close examination and description. The first five minutes of the 100th hour of driving would yield a wholly different picture. Learning would mean that the whole of mental life occasioned by the driving was ridiculously simple and the first five minutes of the 500th hour of driving would yield practically nothing save the sketchy visual perceptions which one uses in guiding oneself through traffic. All the rest has been automatized. At no time during this description would we come upon facts about the proper distribution of practice periods, the proper methods of integrating muscular patterns, the effective distribution of attention, and a score of other conditions of learning such as conduce to quickness and efficiency in the whole process. One might count the decreasing number of items in the whole experience, beginning with the first confusion and ending with the automatized movements, or one might grade all the items as to clearness, texture, and the like, but even then the record of learning would be of doubtful significance to the learning process itself for the mental accompaniments of many skills are more or less irrelevant to the task that is being executed.

Two men helped mightily in the writing of the early paragraphs of this chapter in psychology, viz., Ebbinghaus and G. E. Müller. Ebbinghaus's work appeared in a notable volume entitled *Ueber das Gedächtnis* (1885). His general problem was to determine (*a*) the relation between the rate of learning and the number of repetitions and (*b*) the relation between retention and the passing of time. To these ends, and in order to eliminate so far as possible the factor of meaning (see p. 95) in the learning process, he devised a series of words known as nonsense syllables, words made up of a vowel joining two consonants. (The German language admits of a different construction but the principle is the same.) He then learned groups of these syllables, noting the number of repetitions necessary to learn groups of different length, the number of repetitions required for relearning after the lapse of a given period of time, and so on through a large number of significant variations in the conditions. The result was the discovery of a large number of facts and principles, most of which have remained unchanged even though thousands of experiments on every type of animal life and in every form of skill have now been performed. There has been, of course, a tremendous addition to these facts and principles, most of which have found their way into the textbooks.

Ebbinghaus was not studying changes in texture of mental process under repetition or during the lapse of time. He was studying the rate at which associative dispositions may be laid down in the nervous system. This, to be sure, was not psychology of the Wundtian type, and yet it seemed to speak of important facts about human beings that were not strictly physiology and certainly not anatomy. Thus men differed in the materials with which they worked and in their views as to what were the essential features of the materials selected.

Thinking.—The most astonishing thing about reasoning from the point of view of the analytical psychologist is the relative poverty of the stream of experience as compared with the complexity and the fruitfulness of the products that issue from reflective thinking. We are given a problem to solve, say in answer to the question, Is it possible for a science to be provincial? We knit our brows, brush the fly away from our faces, say the words "science" and "provincial," have a fleeting recollection of a trip into a remote countryside, and render our answer. The significance and fruitfulness of the answer may be out of all proportion to the materials that accompanied the process. This is characteristic of thinking.

Wundt also saw this discrepancy and realizing that an analytical psychology might not be adequate to this and to other higher forms of mental life, he thought to supplement his experimental program by the addition of a new type of psychology, viz., folk psychology. Wundt thought that if the higher types of mental life could not be approached directly through experiment they could be approached indirectly through a study of the products that issue from such life (and in particular, the products of primitive thinking) for, in such a case, the events themselves would be simpler than in cultured groups. So important did this phase of psychology appear to Wundt that during the latter part of his life he devoted his whole attention to it, the result being a ten-volume treatise on folk psychology, and in particular upon the origins of language, custom or morality, and myth. Wundt found that nature had experimented for him and thus produced the materials that he would need in completing the psychological system which could not be completed in the laboratory.

But one of Wundt's most illustrious pupils was not convinced that laboratory methods were inadequate to the higher forms of mental life and, in particular, to thinking, and thus it came about that Külpe founded what was subsequently to be known as the Würtzburg school of thought psychologists.

It was and is patent that a psychology of thought cannot be written around simple mental processes. It is equally patent, however, that if we are to know anything about thought or thinking, we ought to be able to gain it from a person who is actually thinking or solving a problem, and who, at the same time, is attempting to report upon the process. Animals, too, can be made to solve problems, and since the time of Külpe and his school a great many studies have been made on this talent of the lower creatures (see p. 211); but it is not possible to gain a verbal account from an animal of the stages through which it passes in reaching a solution of the problem. With human subjects, however, verbal reports are possible and the introspective method became, therefore, the dominant method in the new investigations.

The type of experiment instituted for the purpose of examining the thought consciousness was simple. The subject of the experiment was asked a question (*e.g.*, What substance is more costly than gold?), or he was asked to compare two weights (thus forming a judgment), or a word was shown and the observer was to report how the word was understood, or a word was shown and the observer was required to add to the stimulus word another which implied a superordinate, a coördinate, or a subordinate idea, and so on. A typical question and answer ran as follows: "Can our thought apprehend the nature of thought?—Observer K. 'Yes.' 6 sec.—The question struck me comically at first; I thought it must be a trick question. Then Hegel's objection to Kant suddenly occurred to me, and then I said, decidedly: Yes. The thought of Hegel's objection was fairly full; I knew at the moment precisely what the whole thing was about; there were no words in it, though, and there were no ideas either. Only the word 'Hegel' came up afterwards, in auditory form." [1]

Of this type of experimentation Wundt said: "These experiments are not experiments at all in the sense of a scientific methodology; they are counterfeit experiments that seem methodical simply because they are ordinarily performed in a psychological laboratory and involve the coöperation of two persons, who purport to be experimenter and observer. In reality, they are as unmethodical as possible; they possess none of the special features by which we distinguish the introspections of experimental psychology from the casual introspections of everyday life." [2]

These certainly were not introspections in the Wundtian sense, but the important question is: Did they yield anything about thought? They did,—three things. First, they brought on a vexatious quarrel, as to whether thinking rested upon a new simple element, the "thought element." The quarrel was settled in the negative. Secondly, they indicated clearly that the most important factors about thought come from the nervous system. Most thinking is poor in mental process,—even in ideas. The problem (Aufgabe), the determining tendency, the attitude (Bewusstseinslage), and cortical sets and dispositions were derivations from the nervous system. Thirdly, the inference was drawn that much light might be thrown upon thinking by the study of problem-solving among the lower animals and among children. In more recent years psychology has turned to the problems suggested by the last two comments.

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[1] Quoted by Titchener (*Experimental Psychology of the Thought Processes*, pp. 91–92) from Bühler, one of Külpe's students and one of the foremost European psychologists of the present day.

[2] Quoted from Titchener (*ibid.*, p. 79) from Wundt, W., *Psychol. stud.*, 1907, **3**, 334.

If we ask the questions: Is thinking a product of mental activity or a configuration of mental process? Is thinking a mode of operation of the nervous system? Is thinking the unique product of an independent and dynamic soul? of The Mind? we shall appreciate once more why it is that the history of psychology is many-faced and why it is that psychologists even now look askance at one another.

Genetic Psychology.—John Locke, an illustrious English philosopher of the early part of the 17th century, made an enquiry into the origins of knowledge with a view to discovering what kinds of knowledge owe their existence to experience and what, if any, owe their origin to intuition, *i.e.*, to an immediate and untutored conviction that some things must be true and others untrue. Consider, for example, our ideas of space and time. Nowhere do we see space or time and yet all objects are in space and endure throughout time. From whence come these ideas? From whence do we derive all of our other ideas that appear to have no immediate relation to experience? Locke's answer was that they come, appearances to the contrary notwithstanding, from experience. Many philosophers before him and some after have insisted that we gain such ideas through intuition, that is, through the immediate conviction that the shortest distance between two points is a straight line, that the circumference of a circle is in all of its parts equidistant from the center, that God is just, that every effect must have a cause, and the like.

Locke's method was to analyze experience into its elements and thus to show that all knowledge, upon analysis, is reducible to certain elements. Once having gotten the elements he reversed the process and asserted that these elements, being the first to appear in the experience of the infant, are the items out of which subsequent knowledge is built. Thus he meant to prove that all knowledge comes by way of experience. It was this systematic presentation of the whole matter that led to that distinction between rationalism and empiricism which we have already found so significant in the history of psychology (pp. 46ff.).

Wundt used a similar faulty methodology. He meant to write a genetic psychology, a psychology that would reveal the origin and development of perception and the origin and development of all types of mental life in the child, the animal, and the race. In the analysis of mental life he discovered certain elements, the sensations, the images, and the simple feelings (which were not, as the reader himself will see, the same thing as Locke discovered). These elements he took as marking the original types of simple experience, the genetically prior types of mental processes out of which, in the life of the child, of animals, and of primitive men, the more complex forms of experience are developed. His genetic psychology was thus written without his ever having made a study of the mental life either of the child, or of animals. As a matter of fact since the child and the lower animals are not able to report upon their own mental lives, that is, since they are not able to introspect, there could be no dependable child psychology and he frowned, therefore, upon Preyer's *Mind of the Child* (*Die Seele des Kindes*), a pioneering book in this field, and one that has never ceased to be a source of information to subsequent workers in the field. Animal psychology was incorporated into his writing relatively late and then only with a view to drawing certain comparisons between the conjectured mental life of the animal subject and the described mental life of the human subject.

We now see that it was impossible for Wundt to write a genetic psychology because the real meaning of Darwinism had not made itself felt at the time the first experimental programs were formulated. Wundt took the notion of evolution and tried to apply it within a range of thinking that was already established. He tried to take it as something that was to be added to psychology just as men added an engine to a wagon and called the result an automobile! He did not see that Darwinism was to bring about a change in the whole frontage of psychology rather than remain as a mere addition to what had already been done. In the next two chapters and in the whole of Part II we shall find abundant evidence of the change through which psychology has passed because of the leavening influence of biology.

CHAPTER III

SCHOOLS OF PSYCHOLOGY

Introduction.—The ideas which the physiological psychologists planted so carefully and watered so generously germinated, grew, and brought forth fruit most abundantly. But Wundt, as we have seen, refused to pluck some of the fruit from his own orchard. He insisted, moreover, that fruit plucked by others from some of the trees of his own planting came in reality from other trees. As a matter of fact, other men were planting other trees and as was suggested at the beginning of the first chapter no one knows whether all the fruits that are garnered from year to year belong to the same species or not. This ignorance, however, does not and has not hindered the active cultivation of the whole orchard after the most improved methods.

The result has been remarkable. Fruits that are called psychological have increased from year to year. We are to partake of some of them not because the ones we select are the most luscious or commercially the most valuable nor because we believe that having tasted a few we shall have tasted all, but with the intention of finding out how the psychologist goes about his planting and his reaping.

But a figure of speech can be carried too far. Let us drop it and proceed to a preliminary survey of the major divisions into which psychological facts seem to fall. These divisions exist because intellectual talent appears under such varied aspects. Wundt's definition of the subject matter of psychology seemed inadequate not only to other men but it was inadequate to his own program as well. Moreover, there were still those who believed that the experimental mode of approach to mental life was not the most fruitful approach. Finally, it was not easy for the first experimenters to get wholly away from a long history of philosophy. From two sources, then, *i.e.*, from difficulties internal to psychology itself and from men whose primary interest was philosophical or practical rather than scientific and experimental, facts have been discovered and principles formulated which have led to the establishment of various schools of psychology. We shall begin with the analytical school or with mentalism, for this mode of psychologizing was a direct product of Wundtian laboratories. Moreover, because of its history and because of the laboratory technique which supports it, it has been the most influential of the prevailing schools. In addition to this mode of psychologizing we shall consider in turn associationism, empirical psychology, gestalt-psychology, dynamism, functionalism, and behaviorism.[1]

In making this survey of the schools of psychology we shall be guided by the various ways in which men have viewed the normal adult, first, because the rest of the book will take us into other phases of the entire subject matter and, second, because the normal human adult may often be used as a point of reference for outlying portions of the whole science. It is always possible, for example, to state the facts of animal behavior as some sort of relative of normal human behavior, the child may be viewed profitably with respect to the average adult, and the psychopathic hospital derives many of its clinical descriptions by drawing a comparison between the behavior of the mentally sick and the known facts about normal mental life and behavior.

MENTALISM

An experiment, as we have found, may aim in either of two directions. It may aim at a controlled *change* of the experimental setting so that one may get an account of variations or fluctuations in the object or event under examination (*e.g.*, the changes in the freezing point of the acid in your automobile battery under changes in the specific gravity of the liquid), or it may aim at the maintenance of *fixed* or unchanging conditions surrounding an object or event in order that this object or event may be exhaustively described (*e.g.*, keeping the temperature, the acidity, and the illumination of the globule of water constant in which you have placed an amœba for microscopic examination). Experiments which aim primarily in the first direction lead to what is called explanatory science. The initial interest of such an investigator is to find ways of controlling objects and events. It is obvious that this type of scientific investigation lends itself readily to technologists, that is, to men who are interested in what is known as applied science. Experiments which aim primarily in the second direction lead to what is called descriptive science. Such an investigator likes to speak of "pure science," "science for its own sake," and the like. The aim of explanatory science is to find as many significant cause and effect relations as possible, while the aim of descriptive science is to render a complete description, a faithful carbon copy of objects and events.

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[1] Read *Psychologies of 1925* (by various authors). Publ. by Clark University, 1926.

As a matter of fact, these two modes of experimentation are ordinarily used in conjunction with one another; but in the history of psychology this has not been so true as elsewhere in other sciences. We have already suggested that Wundt preferred descriptive science, that his aim was to render an intimate description of every mental event which could be produced under conditions stable enough to permit extended observation. Since the conditions which surround the appearance of any given mental event are largely physical and physiological it is clear why the Wundtian psychology was called a physiological psychology.

But at the hands of Wundt's students and particularly at the hands of one of his most illustrious followers, viz., Titchener, experimental psychology became less and less physiological and more and more psychological. It became more and more psychological (*a*) in the sense that physics and physiology were used incidentally, that is, only as a part of the necessary experimental setting (a tuning fork, for example, to produce sounds, or a series of colored papers to produce visual sensations) and (*b*) in the sense that it depended more and more upon a method which came to be uniquely its own, viz., the method of introspection.[1]

Introspection.—Most people think of introspection as equivalent to being moody or despondent. We speak of introspective people as people who are absorbed in their own inner affairs. But this is not scientific introspection. Let us assume that, under experimental conditions, we are looking at a red surface, say a small sheet of red paper upon a gray background. The printer might describe the texture of the paper and the shade of the ink and the physicist might describe the color as standing nearer one point in the physical spectrum than another; the housewife might describe the color as a good or a bad color for a dress or for house decoration, but the mentalist insists that he takes *redness*, the relatively simple ongoing conscious process which we may name as "redness" and describes it, not as a part of the spectrum or as a part of a dress or as a product of printer's ink, but describes it for its own sake. He says that it has or is a certain hue (or color quality), it has or is a certain tint (light or dark), it has or is a certain richness (or chroma), it has or is a certain clearness (it is or is not the clearest among the many processes that may be in the stream of consciousness at that particular moment), and so on. Introspection is, therefore, the direct observation by a trained observer of any process or group of processes which may be selected from the whole stream of experience under the particular experimental conditions laid down. Introspection is the observation of mental processes just as inspection means the observation of a cell or a star.

The astronomer does not attempt to direct his telescope upon the whole heavens at once. The anatomist does not direct his microscope upon the entire human body. Each selects a part of his particular subject matter, the astronomer a single star

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[1] Read Titchener, E. B., *Textbook of Experimental Psychology*, 1919.

or a segment of the sun, the anatomist a single cell or a portion of a cell. Likewise, the trained observer in psychology does not direct his gaze at a whole complex stream of mental life. He selects a single experience, or a part of a single experience. Thus psychology, as the experimental study of experience or of mental life, follows the methods taken by the other sciences and turns its attention first toward problems of analysis. The task is to take the whole stream of experience piece by piece, item by item, describe wherever description is possible, reduce to its lowest level the number of qualitatively different items which are to be found in the whole stream, and when this is done the science is done. On p. 50 we tried to describe five minutes out of the mental life of an average spectator in the football stands. We found the mental life of this spectator to be made up of perceptions, memories, resolves, deliberations, moods, and the like. The problem of mentalism, or of descriptive psychology, is to take each one of these experiences, dismember it until the simplest elements are found, and then render as exhaustive a description of the elements and of their relations to one another as experimental technique and close inspection will admit.

The Nature of Analysis.—We may illustrate the character and the value of psychological analysis in the following manner. During and after turning rapidly upon the heel the subject of the experiment reports an experience of dizziness or vertigo. This is a very complex and consuming sort of experience in which objects are seen to be whirling about the head, one's stomach is felt to be turning inside out, and one's brain appears to be swimming about inside of the skull. The experience is so sudden and so highly organized an assault upon mental life that it was for a long time thought to be wholly unanalyzable. Under experiment, however, and by use of the proper methods, the whole experience breaks apart into a great variety of much simpler types of experience. There are upward and downward pressures in the viscera, changes of temperature about the face, a gripping pressure near the diaphragm and in the chest, an increase of pressure running up through the neck into the head, muscular pressures and pulls in the arms, neck, face, and especially about the eyes, bad odors and tastes, and an increased flow of saliva. All of these things taken as a whole, that is, in a single pattern, yield the experience we call dizziness. When taken item by item, there is, of course, no dizziness.

The Elements of Mental Life.—Mentalists are now generally agreed that all phases of mental life will reduce, under close observation, to at least three kinds of simple events. These simple events (they are called the simple mental processes or mental elements) are the sensation, the simple image, and the simple feeling or affection. Other elements have, of course, been urged. Of these a will element said to characterize the experiences of choosing and resolving, and a thought element said to be discoverable in thinking or reasoning, are the commonest. There are also feelings of relation (feelings which are expressed by the words 'and,' 'but,' 'thence,' etc.), and a dozen or so other fairly simple modes of experience which have been urged at one time or another as necessary to account for the total stream of consciousness. The claims of all of these mental elements have not been experimentally substantiated, although it appears that any change will be by way of addition to the three first mentioned rather than by subtraction.

Sensations are elementary processes found usually in our perceptual experiences, that is, those experiences occasioned by events outside of us. Sensations constitute such experiences as the visual perception of an accident upon the street, the auditory perception of an operatic chorus, the tactual perception of objects in contact with the skin, the olfactory perception of a rose bed, the gustatory perceptions of coffee or tea, and the like. Images are found most frequently in thinking, imagining, and remembering. Visual images, for example, are often used in the recollection of last year's football game, while auditory images might be used in the recollection of the band concert of a month ago. Simple feelings or affections enter largely into the composition of our emotional experiences and our moods. Joys, hopes, fears, and depressions yield, as a principal component, various shades of affective coloring. Opinions differ as to how many of these shades there are. Writers agree most often on two, viz., pleasantness and unpleasantness. That is, pleasantness or unpleasantness are said to be suffused through patterns of organic sensations, the variable *quality* of the mood or emotion owing its origin to the nature of the pattern. Moody depression, for example, is composed of unclear organic sensations similar in quality or kind to those which are discovered in fearful apprehension. The processes or elements found in the two experiences are much the same, but the patternings, the total experiences, are different.

The Attributes or "Properties" of the Mental Elements.—Sensations, simple images, and simple feelings are called the elements of mental life for two reasons. In the first place, attentive observation will not show that a simple tone, for example, has any parts in the sense that a chord has parts. The total perception of an accident upon the street includes visual sensations of color and of gray, auditory sensations of tone and noise, and even gustatory and olfactory sensations. The whole experience is, in fact, a complex which admits of resolution into smaller parts. But the individual sensations, the redness experienced when looking at blood, for example, does not yield parts in the same way. *Redness* is not apprehended as being *composed* of anything. Images and feelings likewise show no parts.

In the second place, the mental elements have certain attributive properties analogous to the attributes of the elements of other sciences. The chemical elements, for example, are distinguished from one another by properties, that is, by characteristics the absence of which would mean the disappearance of the element as a describable entity. Hydrogen, as we know, has certain physical properties which distinguish it among the elements. It has also chemical properties which define its relations (combining-power, for example) to the other elements. The mental elements are also said to have properties or attributes. It is obvious that a mental process could not exist without some degree of intensity, without lasting a shorter or longer time, or without presenting some other distinguishing quality. As a matter of fact all sensations have at least four attributes, viz., intensity, duration, clearness, and quality. Two sense-qualities, visual and tactual, appear to have a fifth attribute called extensity.

Clearness is an attribute which is said to distinguish sensations because of the relation they bear to one another in the whole stream of mental life at any given moment. In a noisy room a person may be speaking and yet the actual perception of his voice may be extremely unclear and obscure or extremely clear, depending upon whether we are attending to what is being said or not. Clearness is variable independently of intensity. As a matter of fact, all of the attributes of sensation are independently variable. A certain sensation of color may be more or less intense than another color of the same duration, the same clearness, and the same quality. An auditory sensation may be equal in intensity, in duration, and in clearness to another auditory quality, but differ from it in pitch, in volume, and in mellowness. Visual and tactual sensations are not only more or less clear (with respect to other processes running their several courses at the same moment), more or less intense and more or less enduring, but they are also more or less spread out, or extended. This is the meaning of extension. A visual sensation of redness which had no extent or no spread-outness would be no sensation at all.

Sensations are derived ordinarily out of perceptions. Simple images are derived ordinarily from memories, from imagination, and from thinking. Recall yesterday's luncheon. You see in your mind's eye the table, the friends, the food. You may even taste in your "mind's mouth" the salad or the dessert. The images which you use in this act of recollection are faded "copies" of the sensations you experienced while actually eating the luncheon. Search through your memories and you will find no simple images that are not more or less faded duplicates of the original sensory processes. For this reason the psychologist speaks of centrally aroused processes (simple images) and peripherally aroused processes (sensations). Memories are revived because of events in the central nervous system, while sensations are occasioned because of events external to the nervous system. Images, then, have the same attributes as sensations. They differ only in that they are not often so intense as sensations and they are not usually so clear as sensations.

Simple feelings, or the simple affective processes, are component parts of our moods and emotions. They have the attributes of intensity, duration, and quality; but they are said not to have the attribute of clearness. It is said that one cannot attend to a feeling as one attends to a sensation.

We are now able to appreciate a little better the program of the introspective psychologist. His first task is to tease out of a complex perception or out of a memory or out of an emotion and a mood the elements, the mental processes, the simplest components of the whole, and describe each in terms of its attributes or properties.

The Organization of Mental Life.—Implied in analysis and coördinate with it is the complementary problem of organization or synthesis. Fifteen billion neurones are not a nervous system. They are not a nervous system until they are put together in a certain way. Five million bricks are not a house; but they may be constructed into a house. Mental processes put together in a certain way are a perception. Springs, shafts, and wheels arranged with respect to one another are a watch. In short, objects are always built upon a plan. If there are no laws there are, at least, types of organization. There are modes of joining things together. Mental life is *composed* of processes, but it is also *constructed* of processes. We are led to ask, then, about the principles of mental organization.

Fusions.—Primary mental organizations are said to be of two kinds, viz., fusions and colligations. In fusions, the elementary processes are found together in such close conjunction that they lose their own individuality in contributing to the resulting experience. In the fusion the sensations lose their independent character much as do hydrogen and oxygen when they combine to form water. The fusion, in turn, takes on qualities and properties of its own, properties which are peculiar to it as a whole. Thus, any tonal perceptions are fusions, for the tonal sensations forming a chord melt into one another so completely that they tend to lose their own specific qualities or properties as sensation in favor of the properties of the chord as a whole or unit. Consequently the chord may at first appear as unanalyzable. Smell and taste sensations also fuse together in this way. The perception of the taste of coffee, for example, is a fusion made up of a certain bitter-sweetness, a given temperature quality, and perhaps a variety of olfactory qualities. Many of the cutaneous perceptions are also fusions. Wetness, dryness, sharpness, bluntness, oiliness, roughness, and smoothness are cutaneous perceptions difficult of analysis but made up, nevertheless, of distinguishable cutaneous and kinæsthetic processes, as can be proved by artificially adding, say a pressure and coolness together, to produce the perception of a wet object.

Colligations.—In colligations, the individual components keep their identity; there is a certain spatial and temporal side-by-sideness about them; they fall into mosaics. Thus visual sensations almost always fall into patterns instead of fusing with one another as do tones. The colors and grays give a picture, not a chord. Most of our perceptions of visual and of tactual space, and of size or extent are spatial colligations. The perceptions of duration, time, rhythm, movement, and melody are temporal colligations. Here the side-by-sideness is measured in temporal rather than spatial terms.

Groups of fusions and colligations form organizations of still higher order. A series of chords, for example, may form a melody. A whole series of colligations makes up a landscape. The group of simple qualities may form here a tree, there a cloud, still a third group a roadway, and so on.

Attention.—But there are other more complicated problems of organization in mental life. It rarely if ever happens that mental life is made up at any one moment of a single line of fusions or colligations, like a single column of soldiers defiling along a roadway. The column is wide, or to change the figure, the stream of mental life is broad. Much water may be crowded between the banks. We must answer the question, then, as to what relation obtains between the various mental events that may be running their several courses at the same moment. In ordinary language the question is: Are all objects attended to with the same degree of clearness at one and the same time? The answer is obvious. In the total stream of experience some objects are always apprehended more clearly than others. There is always something to be attended to to the exclusion of everything else. There is, then, in the whole stream of mental life a problem of organization, a problem of momentary relationship, and this is, from the point of view of the analytical psychologist, the problem of attention. At an upper level of clearness, and under certain conditions which have been determined in the laboratory, a limited number of processes may run their several courses at one and the same time, while at a second and lower level of clearness there is a constantly shifting mass of processes seeking to come to the upper level or submitting themselves to some inhibiting force.

Determining Tendencies.—Finally, we must consider the organization of mental life over a long period of time and here we find still other types of *togetherness*. Mental life is organized longitudinally under the influence of determining tendencies, *i.e.*, associative, habituational, hereditary, and problem-bearing tendencies. These words mean that the stream of mental life does not flow on nillywilly, except among the insane. They mean that the order or the sequence of mental events *is* the order or the sequence of physiological and neural events. Associative tendencies are established in the nervous system during the lifetime of the individual and they make it possible for any mental events (or neural events) that have once appeared together in mental life (in the nervous system) to appear together again. Habituational tendencies are also laid down during the lifetime of the individual, and they control the sequence of events in mind in somewhat the same manner. Such tendencies are more deeply rooted in the nervous system and they are related more specifically to bodily movements. Still more deeply rooted are the hereditary tendencies. The word instinct refers to certain urges toward action which run their several courses in a way predetermined by the nervous system, in such a way that a goal is reached which has not been anticipated by the creature. Problem-bearing tendencies mean that the nervous system may, on occasion, be so disposed that only those conditions which favor the solution of a problem come into consciousness. It is not known as yet how problem-bearing tendencies have their origin.

Self and Personality.—Over very long periods of time we discover still another degree of organization, a degree which is commonly designated by the words character or personality trait. These words mean that, in a total lifetime, some types of experience, certain groups of habits, selected determining tendencies, are prepotent to a given individual. Some pieces of music are *characterized* by a recurring melody. In the same way, some individuals (perhaps most individuals) are *characterized* by recurring dispositions, habits, tendencies, and the like. We, their neighbors, learn to know and judge character in that we learn what to expect from others.

The Problem of Meaning.—The significance of a point of view in psychology, indeed the significance of a school of psychology, may be seen in the kind of problems which the point of view favors, and in the way in which it handles these problems. We have just seen what kind of problems mentalism favors but we must now see in more detail how it handles a crucial problem. We choose the problem of meaning.

Perceived objects often point beyond themselves to something else; they have reference to something else which, properly speaking, is not perceived but implied or meant. Let us assume that a company of persons on shipboard has just sighted a black object upon the water near the horizon. The actual perceptual experience is limited, on the side of mental process, to the comparatively few sensations set up by the object itself and by surrounding objects,—the water below, the sky above, etc. But the splotch of black is more than "that black object." It implies something; it is freighted with reference to other objects. It is a rowboat with exhausted mariners needing succor, or it is the back of a whale, or it is the lost transatlantic airplane, or it is a bunch of seaweed, or it is an old barrel, or it is an old mine, or it is a submarine. The single object thus points to, suggests, or leads on to something further.

Perception and Meaning.—The relation between a perceived object and the references or implications which it may carry can be further illustrated in the following ways. Meaning or reference may sometimes be stripped from an object. The repetition of a word—hippopotamus, for example—soon renders the word meaningless. Nothing is left but a relatively meaningless jangle of sound. Meaningless objects may take on meaning and old meanings or references may be augmented by new implications. It is probable that a black object upon the water prior to 1916 would have meant submarine only under unusual conditions. From 1916–1918, however, submarine might be the first and most persistent of the implications hovering around such an object. The words of a foreign language are meaningless (excluding for the moment the fact that the lines and letters mean "foreign language"); but after a period of study the words and lines are replete with reference. Objects and their meanings may become temporarily dissociated in time. An object seen in the dark causes a moment of panic, for it has no precise meaning, but in a moment we see it for what it is, viz., the neighbor's dog. Over the telephone we hear sounds plainly enough, but it is only afterward that the meaning comes. The same object may, as we have already seen, carry a multitude of implications; but likewise different objects may carry the same meaning. The spoken or the written word football, the sight of a brownish solid object, the smell of rubber and leather, the sight of a jersey with its numerals, the sound of a multitude of cheering voices, may all convey the meaning of "a football victory."

What Is Meaning?—Of the fact, then, of implication, reference, meaning, pointing to something else, there can be no doubt. The questions we must answer are: What is meaning? How can it be explained? The answer of the analytical psychologist is simple and straightforward. In the total perception there is said to be a core of mental processes, usually sensations, which are conditioned by the object perceived; but this core is surrounded by a fringe of other processes, perhaps imaginal processes, which carry the meaning, which lend significance to the core itself. It is in the shifting relations of the fringe to the core that the mentalist finds an explanation of the facts described above.

A more important factor, however, is the following. Meaning or reference may have been carried originally by a fringe of kinæsthetic and organic processes which implied in turn that the organism had assumed, under a stimulus, a certain bodily set or attitude. But in addition to overt bodily set or attitude there are times when meaning may be carried simply and solely by physiological processes, by some set or disposition of the brain. "When the practised reader skims a number of pages in quick succession; when the musician renders a composition in the prescribed key; when an accomplished linguist shifts from one language to another as he turns to his right or left hand neighbour at a dinner table; in cases of this kind there need be no discoverable context; the stimulus presses the button, and the brain, prepared by constant practice in the past, now does the rest. The experiences *mean*, positively enough; the 'sense' of the page is grasped, as the eye hurries over the lines; the three flats on the staff set the player's hand and eye for the key of E♭; the question put in French is suitably answered in the same language; everything takes place *as if* there were a fringe of images that gave meaning to the bare perceptions; and yet imaginal fringe and kinæsthetic setting may be conspicuous only by their absence. Of course there *has been* context; one does not learn French and German, or transpose on the piano, by gift of a ready-made nervous system; even after years of work one may be a little uncertain of the German auxiliaries, or have a repugnance to four sharps. The point is, however, that an habitual and often-repeated context does, presently, lapse altogether; the nucleus is not always supplemented; the nervous system can now do, by a set or disposition that has no mental correlate, what it used to do by processes that had as accompaniment the sensations or images of the context." [1]

Here we have a suggestion of two explanations of meaning or reference. There is, on the one hand, the thought that meaning is a special contribution which mind (mental stuff, imagery) makes to the processes of perception (to a core of sensations), processes which are, in good part, dependent upon physical and physiological factors (stimulus and sense organs). There is, on the other hand, the thought that meaning, carried first by either incipient or actual tendencies to action, comes later to be carried by a special set or disposition of the nervous system. Meaning, then, is what the organism *is about to do.* We shall have occasion to refer to this matter again (p. 155) and to find that there is a physiological way of considering these phenomena. It is important that we do so, for the fact of meaning is one of the most troublesome facts with which psychology has to deal.

Summary.—Wundt's physiological psychology and the analytical or introspective psychology which came out of it (mentalism), was a psychology without a soul, and it was a psychology without explanatory principles derivable from within the range of its own facts. It was a science of psychology in the same sense that the Linnean classification of the whole organic creation was a biology. It was alleged that the most vital phases of intellectual life and of behavior, the purposive, striving, problem-solving acts of an individual had no home in a structure composed of sensations, images, and simple feelings.

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[1] Titchener, E. B., *A Beginner's Psychology*, 1916, pp. 120–121.

The facts that make life meaningful, that make intelligent behavior an agency as well as a natural fact in the world, were drawn from the nervous system in terms of stimulus, determining tendencies, instruction, set or attitude, problem-solving tendencies, associative tendencies, and the like.

It was for these reasons that Wundt's psychology collapsed on the far side of perception. The higher mental processes, memory, imagination, judgment and thought, are more than colligations of sensation, image, and simple feeling. Wundt saw this and where his laboratory failed he turned to the psychology of primitive groups. The logic of his method was as follows: In primitive groups we find custom, language, and religion in the process of being created. A study of the products should reflect the talent of the creator. In folk psychology, therefore, the failures of the experimental laboratory might be corrected.

In the meantime laboratories were being founded all over the civilized world. This story is an interesting story of itself. Where laboratories multiplied, facts multiplied, and where facts multiplied, theories multiplied. Within a generation after the first laboratory, psychology was ready to take its place as one of the major sciences. It was still young, however, and its various moods fought with one another, its various ambitions collided, and it is to this aspect of the history of psychology that we must now turn.

The Association Psychology

Perceptions follow one another in an unending series from early morning until the last moment of wakefulness at night; but this kind of "following one another" is not exactly a problem to the psychologist. The sequence of perceptions is the sequence of physical events. We listen to a melody as it is played through from beginning to end and our changing auditory perceptions are occasioned by the changing score. We drive through a countryside and our perceptual trains are occasioned by the ordering and arrangement of the objects which make up the countryside. We spin along in the automobile and it is natural that our perceptions should also "spin along" the one after the other in a series determined by the objects and events seen and heard.

The situation is different, however, with what we commonly call the sequence of ideas. When we close our eyes and give ourselves over to a period of reflection we think of a whole series of objects and events which come and go, not by chance but in just as orderly and meaningful a way as perceptions come and go. Here we do find a problem for we may ask how ideas start, or how they are occasioned, and we desire to know what the principles are that govern the formation of a train of ideas. The sequence of ideas is not the sequence of the original perceptions. If it were we could merely live again the order we had once seen or heard or felt. This we do not do. Ideas follow one another in new ways, they group themselves together in new patterns, and thereby hangs one of the oldest stories in psychology.

Laws of Association.—The problem raised by the sequence of ideas was answered by Aristotle with the assertion that ideas that are similar to one another or that owe their origin to objects or events that have occurred contiguously to one another, either in space or in time, have the tendency to appear together again. During the early part of the 17th century this law or principle of association by contiguity and by similarity was raised to a central doctrine of psychology and philosophy by the great English philosophers, Locke and Hume.[1] This psychology has had a venerable history, and it was not until our own generation that the fatal weaknesses of it were clearly seen.

The psychological problem that arises when we consider the fact that ideas appear in trains and in topical groups was stated by Locke in these words: "Some of our ideas have a natural correspondence and connection with one another; it is the office and excellency of our reason to trace these and hold them together in that union and correspondence which is founded in their peculiar beings. Besides this, there is another connection of ideas wholly owing to chance or custom. Ideas that in themselves are not at all of kin come to be so united in some men's minds that it is very hard to separate them; they always keep company, and the one no sooner at any time comes into the understanding, but its associate appears with it; and if they are more than two which are thus united, the whole gang, always inseparable, show themselves together." [1]

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[1] Read Warren, H. C., *A History of the Association Psychology*, 1921.

The philosophical and empirical problem which issued from this observation of Locke's was to determine how it comes about that ideas can be associated together, and how it is that each member of a "gang" tends to bring the others along with it. Had Locke continued to make it "the office and excellency of our reason" to explain the matter he and his followers would have remained rationalists. It would have been easy to say, "These ideas have appeared together because the reason has put them together." But Locke and especially some of his followers took another road. They revived the old Aristotelian principles of association. Ideas appear together now because they have appeared together at some previous time in the form of perceptions. We see two objects together today; we remember them together tomorrow.

This is, of course, a great simplification of the whole matter; but since we are trying to illustrate problems rather than to criticize details we shall have to let the matter rest where it is. If we remember that the program of associationism had to be worked out, first more or less logically (Hobbes, Locke, Hume), then in terms of a crude physiology (Hartley), then with more logic and a great deal of new and accurate knowledge about the nervous system (the two Mills and Bain), and finally with an evolutionary philosophy (Spencer), we have the main outlines of English Associationism.

The Error of Associationism.—The idea of Napoleon calls up the idea of Alexander the Great. Why? Because there is a certain similarity between the two. But one may ask: The two what? There is, of course, a similarity between Napoleon and Alexander the Great in so far as they were both remarkable generals. But a similarity between men is not a similarity between mental processes. This is the rock upon which associationism stumbled. The whole psychology was, moreover, too simple. The greatest exponent of pure associationism, Alexander Bain (1818–1903), strained every sinew to explain the entire range of mental life and of behavior with this single principle, but the principle could not suffice. Bain's psychology went quickly into history, partly because the doctrine of evolution changed the whole perspective of men upon psychological and behavior problems and partly because Bain's greatest works almost paralleled the establishment of the first psychological laboratories on the continent. A psychology gained by logic could not hope to compete against a psychology gained from the laboratory.

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[1] Locke, J., *Essay concerning Human Understanding*, Bk. ii, Chap. 33, §§ 5, 6.

Rational Psychology

In order to lay our finger upon significant differences between the old and the new psychologies we have had to draw a rather sharp distinction between rational and empirical attitudes toward phenomena. Rational psychology proceeds upon the assumption that the mind, or the reason, is able to arrive at facts about itself and about other objects through mere cogitation. The only requirement is that one shall think straight. One is guided by logic. Progress consists of showing how previous thinkers have not thought straight and of attempting to think a little straighter by profiting from their errors. Empirical psychology, on the other hand, goes to experience and to experiment. It finds its facts by observation and makes such generalizations upon these facts as they themselves warrant.

As we have seen, some men have never been able to agree that psychology should be an experimental science. The first experimental psychology was a physiological psychology, and the reader will recall that neither its methods nor its points of view were adequate to the study of the higher forms of mental life. Experimental psychology was an analytical psychology, its best friends were physiology and neurology, its search for units of stimulus that would excite just noticeably different qualities of sensation did not seem a dignified or satisfactory program, and most of its principles of explanation had been derived from neurology rather than from the realm of mental life itself.

All through the early history of physiological psychology, therefore, men urged that students of mental life should return to their ancient home, that is, that they should accept the independent reality of mental life, accept the native talent of the soul to examine itself and its operations, and, under critical and impartial conditions, render a descriptive account of mind more in keeping with the dignity of man's noblest quality, viz., his intellect.

Brentano.—It is a strange coincidence that the book which was to define anew for modern psychology this rational, and at the same time, empirical, point of view was published in the same year as Wundt published the first edition of his *Grundzüge.* This book was Brentano's *Psychologie vom empirischen Standpunkte*, published in 1874. It marked the birth—one should say, the rebirth—of a rational psychology which was at the same time an empirical psychology in that it attempted to make use of any experimental conditions which would aid the mind in finding out things about itself.

Brentano's book appeared at an unfortunate time. In 1874 the experimental sciences were rapidly achieving a dominant place in European culture. Philosophy and the fruits of philosophy were in disrepute. The experimental laboratory, timing instruments, microscopes, kymographs, were the symbols of the day. The discoveries that were coming out of the laboratories fired the imagination of men and it seemed that never again could philosophy do more than assemble scientific facts or search for the larger points of view suggested by research. But Brentano and some of his followers (Meinong, Stumpf, and Husserl) looked askance at the mechanical and arid picture which physiological psychology was drawing. Mentalism meant collections of items, of parts. The mighty intellectual achievements of great men, even of the great men of that day in science, appeared in the pages of the psychological journals in terms of sensations, simple images, and simple feelings.

The difference between the points of view of rational psychology, on the one hand, and of physiological psychology or even mentalism, on the other, can be sharply drawn in the following way. Physiological psychology was remarkably adequate to the study of all those psychological problems which sustained obvious and demonstrable relations to physical and physiological events, such problems, for example, as sensation and perception. As we have seen, however, this psychology failed on the far side of perception and Wundt sought to bolster it up by appealing to folk psychology (p. 77). Physiological psychology failed in the sense that it gave no leverage upon the higher intellectual functions and mentalism failed because the uniqueness of mental life was lost by the very process of analysis which made a physiological psychology and a descriptive psychology possible. The attack which the students of Külpe made upon the thought processes was hailed as a great achievement of science and a great justification of the analytical and descriptive methods; but we see now that thinking is something far more than the sensations and images that are discovered when thinking goes on. Even the attempts of mentalism to bolster up the analytical program by appealing to all sorts of determining and controlling tendencies in the nervous system has not led to a convincing account of what is done by the organism when it thinks. Moreover, the analytical psychology has never been able to approach in an adequate way the problems raised by the attitudes, sentiments, convictions, and intuitions of men, yet no one can doubt but that these experiences play a tremendous part in their lives. In other words, the new experimental psychology did not seem to be able to cope with many of the problems which had been approached by the old mental and moral philosophers and by the scholastics, and there were a few thinkers who believed that psychology could no more afford to lose sight of these facts about men than biology could afford to lose that point of view which Darwin introduced. Morphology (the science of parts) never has been and neither does it now show any signs of becoming a *living* science, and in saying this nothing is said against its scientific importance.

Subject Matter of Rational Psychology.—Brentano defined the subject matter of psychology in the following terms: "The difference," he said, "between psychical and physical phenomena is found in the fact that in the former there is always a reference to something beyond themselves while the latter never point to anything beyond themselves." This pointing to or reference to something else is not to be confused with the discussion we have already given of the nature of meaning, although the facts are somewhat the same. Brentano was attempting to use "pointing to" or reference to as a criterion of what is mental. We say of an idea that something is ideated, or of hating that something is hated, and so on. An idea or a hate is, therefore, mental; it stands in contrast to sticks and stones which do not refer beyond themselves in this way. Having gained a definition of the mental, Brentano proceeded to work out the details of his psychology. The fact that the psychical always pointed beyond itself implied that the psychical was active rather than passive. As a matter of fact, Brentano said that he was going to take The Mind as he found it, and, as one of the commentators on his psychology remarks, he found it in use. This is what most of us do. The Mind is something that is used, something that can be put to work, rather than something that is wholly passive in its nature.

Since The Mind is always active, one of the first tasks of rationalism is to make a classification of its modes of acting. We are not here interested in this classification, although it was done by Brentano with splendid logical thoroughness. He reviewed what all the philosophers had had to say about the matter, showed where they had fallen into error, and proceeded to erect his own logical construction. It is this aspect of Brentano's psychology that is of most interest to us in this paragraph.

One must not remain blind to the fact that some of Brentano's students did a great amount of experimental work (Stumpf, for example), nor forget that other students could readily apply the results of such a psychology to the arts and the industries (Münsterberg, for example), nor may we forget that the title of Brentano's book contained the word empirical, as if he meant to align himself with the experiment movement; but in spite of these facts, Brentano's psychology was rational in intent and in outcome. He would make use of experiments where experiments were forthcoming, he would go to experience in order to gain materials to be used in his hours of reflection; but the cardinal assumption of this mode of psychologizing was the final authority of Reason. When Brentano was through with his thinking, his psychology was finished. The main outlines were there for all time to come. Further reflection might change some of the details and he might even bow here and there to experimental studies; but these were all incidental; reason had done its work and the matter was ended.

As we have already said, Brentano's book appeared at an unfortunate time. The age of science was against it. But the work which Brentano did was not lost. A part of the impetus which he gave to a revival of rational psychology spent itself in logic and the chief representatives of this logic, Meinong and Husserl, have done much to quicken thinking in this field. Another part of the impetus went, however, to a defense of those aspects of mental life which had been lost sight of in the analytical psychology, viz., the uniqueness of mental life taken as a whole. This aspect of the whole problem was soon to find a champion in what is known as the Gestalt Psychology. But before we consider this new school we must spend a short paragraph on another phase of logical and rational psychology, viz., that falling under the somewhat formidable term Phenomenology.

Phenomenology.—The table at which we may be looking appears brown and square and oblong, but it also appears or looks as though it were hard or soft, heavy or light, rough or smooth. That is, there is a genuine sense in which we literally *see* that the table is heavy or that the wood of which it is made is hard. In a similar way we *see* that a piece of glass is brittle, that a piece of steel is cold or that a piece of mud is soft. In the orchestra we literally *hear* some tones as hard and others as soft. A color may appear melancholy or cheerful, and weather may be forbidding or cutting. In other words, when we see the table as hard or as heavy we seem to be gaining knowledge about the table that ordinarily comes through some other sense organ, say the tactual organs in the skin and the kinæsthetic organs beneath the skin. What do we mean when we say that we can see hardness, or hear softness?

The older psychologies explained these facts in terms of the association of ideas or in terms of sensation and image. Through experience, says the associationist, we have gained the idea that certain kinds of tables are made out of hard wood. Our idea of hardness is then associated with our idea of tables of a certain kind and subsequently, therefore, whenever we see these tables we see them as hard. Mentalism, on the other hand, explained the facts in the same way that we have already explained meaning (p. 93). There is a core of sensations which are occasioned by the table which we are now viewing. There is a fringe of imaginal material garnered from our previous dealings with tables, and this fringe carries the meaning "This table is hard." There is a core of visual sensations occasioned by the glass that stands on the table and this core is supplemented by a fringe of imaginal material which carries the meaning "Glass is brittle." Thus the qualities of an object which are seen but which are not derived from visual sensations may be due to an association of ideas, or they may be explained as meanings which the object comes to have for us.

It is clear that in these two cases we have something more than psychology with which to deal. We have theories of knowledge before us. We have become acquainted with two of the many theories which attempt to explain how it is that we can have knowledge of the external world. For a hundred years, this question has been asked with increasing frequency and today it is one of the central problems of philosophy. The association psychology explained the problem by assuming that the infant has simple experiences of objects about it; these experiences are associated the one after the other, during all the years of childhood and maturity, and by this token we gain knowledge. The mentalist answered the problem by his doctrine of core and fringe. The fringe gives meaning to a core of sensations, these meanings grow with experience and thus we can become acquainted with the world in which we live.

In both of these theories of knowledge it is assumed that all that we can directly experience is our sensations of objects. The redness which we experience is our sensation and not the actual object which occasions the redness. So with all experiences, simple or complex, which we are capable of having. The knowledge we have is not immediate direct knowledge of objects and events in the external world but knowledge which is limited to the range and extent of our own experiences of objects. We do not know about objects, we know about our sensations of objects.

Phenomenology is a theory of knowledge opposed to the above theories. Some of Brentano's students, influenced as they were by the direct observational methods which he employed and influenced also by logical and philosophical factors which are of no concern to us here, felt that the fusion theory of perception was incorrect, that one could actually *see* hardness in the metal by a direct visual penetration into the very nature of the object. Hardness is not seen because of association but because we have an intuition as to what metal must be like.

In a crude way this is what phenomenology means when applied to the field of perception. We shall fall into error, it is said, if we stop with that physical object before us which we call metal. The object which we intuitively apprehend is more real than that; it is the very essence of things; it is the genuine behind appearances. Here we lose ourselves in a maze of words and we should not find ourselves again until we had become thoroughly familiar with the philosophies of Plato and Aristotle and with the hairsplitting vocabularies of the scholastic philosophers. The point we ought to dwell upon, therefore, is this. Phenomenology represents one of the many attempts that are now being made to see mental life in the countingroom, in the market, on the judge's bench, rather than on the dissecting table. It represents a movement, highly abstract and logical, it is true, to take account of other mental facts than those experimented upon so successfully in the laboratory. It has raised again the issue as to whether psychology should become a science, so long at least as science means analysis and dismemberment, so long as it means the apotheosis of the natural world, the world of measure, weight, and number.

Gestalt Psychology

A penetrating analysis of an event or object must not be mistaken for a penetrating insight into the real nature of the object or event. A cell may be selected from an organ, a star from a universe, a neurone from a ganglion, a muscle fiber from a bundle, hydrogen from water, an ant from its colony, digestive juices from a stomach, pollen from a flower, everywhere the single, isolated object or event from the milieu to which it belongs,—all this promotes the discovery of morphological facts, but it may not promote *understanding*. We may list ever so many *items*, but we may not on that account gain a real appreciation of the *wholes* with which analysis began. After all, nature does not present herself to us *element-wise* but *pattern-wise*.

Creative Synthesis.—Wundt saw this failure in the analytical psychology. He saw clearly that the most exhaustive description of the items that make up a perception could not yield a description of the qualities or properties of the perception taken as a whole. We may analyze a single chord from a symphony and say that the chord is composed of so and so many tone-elements. Each element may be described in great detail; but nowhere do we meet with the properties of the chord itself. That fusion of elements which we call the chord has qualities which the single tones do not have. In a similar way we may lay out all of the cells which are to be found in the human body and render an exhaustive description of each. We know that the body is composed of these cells which we have described; but we have not yet described the unique properties of the living organism as a whole.

To meet this destructive and myopic tendency inherent in all analytical methods, Wundt advanced the idea of a creative synthesis in order to bring back into the totalities of mental life those qualities which analysis could not find. This doctrine of creative synthesis meant, first, that the products of analysis, the simple elements of mental life, represent the origins of mental life, the first kinds of processes, the genetically prior elements out of which came the more complex processes. We have already discussed this mistaken notion on p. 80. Creative synthesis meant, secondly, that since no mere collection of items can ever be more than a collection, the unique qualities of the wholes in mental life, say the perception of a melody, of a picture, or the solution of a problem, must issue from the creative power of some special agency. This agency, in a creative way, synthesizes the elements into a unitary pattern and thus we come to the configurations with which we began our process of dismemberment.

There are other sciences which have worshiped at the feet of analysis and they, too, have had to introduce creative agencies in order to rectify the damage done by too minute dissection. Physiology, for example, tore the living creature to pieces; and finding that it had, in the process, lost sight of that unique organic unity which we call life, it was obliged to invent an entelechy that would put life back into the products of analysis.

There is another way out of the difficulty. The argument runs as follows. Since analysis does not allow one to find the unique qualities of mental life which adhere to it in its pristine state, something must be wrong with analysis. It must be that mental life should be described in terms of wholes, properties of wholes, in terms of the total patterns or configurations which nature herself has produced. The last decade has seen, therefore, a new movement in psychology, the gestalt or configuration psychology which sets itself in opposition to the analytical psychology by seeking a description of configurations rather than of elements.[1]

Perceptual Configurations.—The gestalt psychology has been exceedingly productive in that it has lent itself readily to experimental demonstration and research. We shall draw upon one or two illustrations in order to clarify the issues which this new point of view raises.

We begin with the story of the small boy who asked of the zebra whether it was a black animal with white stripes or a white animal with black stripes. Whether we say that the creature is a white animal with black stripes or a black animal with white stripes, we emphasize the fact that the several parts of the total perception gain their character by being taken in conjunction with one another and not separately from one another. We may illustrate the problem a little more schematically by using a geometrical design. Let us assume that we have drawn a number of pairs of parallel lines upon a piece of paper so that we have something resembling a picket fence. If, now, we regard the figure we shall see that the pickets may be taken as pickets while the space between seems empty or we may take the empty space as wide pickets and the space that formerly appeared as a row of pickets will now appear empty. The space that appears empty we may call the *ground*, while the space that appears as a picket may be called the *figure*. It is possible, then, in this experiment to change back and forth from figure to ground and from ground to figure. Now, if we observe more closely we shall see that the space which is taken as figure appears more solid than the ground. Moreover, the ground appears to lie behind the figure. Or, if the relations between figure and ground are changed, that area which formerly appeared as ground, and hence as lying behind, now appears as figure and as lying in front of the space that was formerly figure. It is clear enough, in this simple experiment, that the parts of the total perception derive some of their qualities from the fact that they are members of the whole experience.

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[1] Read Helson, H., "The Psychology of Gestalt." *Amer. J. Psychol.*, 1925, **36**, 342–370, 494–526; **37**, 25–62, 189–223.

Experiments on Apparent Movement.—Experiments in the perception of movement have thrown a great deal of light upon the nature of configurations and they have also suggested that the nervous system itself may act in configured or patterned ways. Every reader of this book has been looking at traffic lights just as the traffic signal changes. He has seen the red light leap up as it were, to the green light, or the green light leap down to the red. There is, of course, no actual motion, but it appears as though something had moved. This observation has been put under experimental study and the conditions for such phenomenal movement are now well known. The fact that there should be movement at all is strange enough since it can be demonstrated with great ease that nothing has moved. Apparently, the movement is a quality of the total perception which arises only when the total configuration lends to the parts some phenomenal quality which they would not otherwise have.

An explanation of this phenomenal movement has been attempted in the following way. The initial stimulus of the total pattern sets up a wave of excitation in the optic tracts of the nervous system. This wave of excitation may be thought of as having a certain irradiation value. Perhaps it is accompanied by something in the nature of an electric field. A moment after the initial stimulus has acted, the second comes and a second wave of excitation chases the first into the optical centers. This second wave, too, may be thought of as setting up some sort of a field. If these two fields lie close enough together, both spatially and temporally, we may think of them as overlapping or short-circuiting and this physiological configuration would be reflected in conscious experience as the perception of movement where there had been no actual movement.

The contrast between mentalism and associationism, on the one hand, and the gestalt psychology, on the other, may be brought into clear light by the following experiment. An animal was taught to discriminate between two grays by gaining food from the lighter and nothing from the darker. Associationism would explain this process of learning by supposing that associative bonds are set up between a particular quality of gray and the idea of getting food. Mentalism would explain the process by supposing that this particular gray comes, through experience, to *mean* food to the animal. If either of these interpretations is correct the animal ought in the future to go to this particular gray for its food no matter where the gray appears with respect to other grays and other colors. But when the experiment was changed so that a still lighter gray was paired with the light gray of the first series, the animal chose its food from the new gray rather than from the one which it had already "learned." It looks, then, as though the animal were reacting, not to a single gray but to a pattern of grays, to the difference between two grays. Here again it looks as though the members of a total perception are not isolated items but have genuine membership in a configuration. By being in the configuration, they gain properties which are to be understood only in terms of the membership, not in terms of an analytical isolation.

The Gestalt-psychology is, then, a reaction against analytical psychology. The movement has been extremely productive in that it has stimulated research and investigation. It is still too early, however, to pass judgment upon its final usefulness to psychology taken in the large.

Dynamism

No phrase is so common in our ordinary speech as "the workings of the mind." It is a common conviction among us that mind "does something," and it would be strange indeed if one or more psychologists had not taken this conviction as a starting point and made it the cardinal feature of a school of psychology. As a matter of fact, this has been done, not only once, but many times, and in many different ways. We can hope to mention only a few of the problems that arise when the task of psychology is conceived in dynamic terms.

Origins of Dynamism.—It goes without saying that the soul psychology gives an initial impulse toward thinking about psychological problems in dynamic terms. The soul was an agent, an effective factor in getting things done, but there are many other suggestions leading in the same direction.

No type of human or animal behavior has been so hard to explain or to correlate with other types as that which centers upon the words will power, choice, volition, and the like. We say that we react to stimuli, and respond to situations; but there are many times in which we appear to act as if we were self-initiating, self-propelling agents, as if we possessed or were a self-directing source of energy. Man, in particular, is characterized by the talent to set himself to a task and continue this task over a long period of time, working often against the most serious difficulties and overcoming the most stubborn obstacles. He seems to be possessed of a driving power or energy which carries him through to a goal in spite of all hindrances. Then again, man has all kinds of desires, impulses, longings, and urges to action which originate, so it appears, within man himself rather than within the range of his effective environment. He formulates purposes and works toward the fulfillment of these purposes.

Interesting confirmation of the dynamic nature of mental life comes from the psychopathic hospitals. There we find patients enough and to spare, in whom an idea or a group of ideas seems to take on enough energy to command the whole trend of life of the patient. Forgotten "memories" are known suddenly to appear and wreak havoc in the mental life of a person because other experiences do not seem to have enough energy to displace the intruder. That whole psychological edifice which we shall come to know as Freudianism (p. 386) is an edifice built upon the notion that mental processes are intrinsically dynamic, that the very core of mental life is nothing more than an entelechy, a dynamic agent, an élan vital, a libido, a striving urgent will to live.

We have met the problem of dynamism before. We found in the last chapter (p. 71) that the founders of psychology could not agree as to the nature of the subject matter of psychology. The purely descriptive psychologist found no place for dynamic modes of expression since his task was analysis and the description of items. He did not face the problems suggested by dynamism until he came to the study of mental organization, and then he faced them by removing them to the nervous system. We say that thinking goes on or that a train of ideas goes through our heads. Mentalism said that thinking cannot help but go on since trends or dispositions are always going on in the nervous system. Likewise trains of ideas pass through our heads because associative tendencies in the nervous system tend to run to completion. The issue, then, between mentalism and dynamism is the issue expressed in the question: Should we speak of the workings of the mind or of the workings of the nervous system? This is, in part, the same issue expressed by the words functionalism and structuralism. It is one thing to describe the "structure of the mind," and quite another to tell how Mind works, what it does, what it accomplishes.

Functionalism.—The reader will recall from the last chapter that the problems of mentalism and the programs of research laid down by this school of psychology appeared before Darwinism. The reader will also recall that mentalism enjoyed considerable success in describing, under controlled conditions, the items which make up the stream of experience. Now it was natural, as Darwinism forged ahead, that some attempt should be made to put the facts of mentalism, the analytical study of sensations, images, and simple feelings, into a biological setting. We see now that psychology should have met biology more than halfway and changed its whole line of attack. What this means has appeared in the first chapter; but twenty years ago it was not so obvious that psychology must make such a fundamental alteration of its program.

Darwinism meant in those days that everything that now exists has survived because it possessed some "survival value." Sensations, images, and simple feelings,—that is, mind in general,—must, therefore, have a survival value. Otherwise mental life would not have persisted. The question is, What gave mental life survival value? The answer that mind or mental life has acted as an agent in biological adaptation, as a dynamic force in bringing about an adjustment between the organism and the environment was the answer given by a school of psychology known as functionalism.[1] The difficulty, offered by dynamic conceptions that were nothing more than revivals of the soul psychology, was evaded if one thought of mental processes as catalytic agents, as items which favored the process of biological adaptation merely by being present during the act of biological adjustment.

Functionalism began, then, with mentalism, but it said that mentalism did not tell the whole story. One must go a step further, it was urged, and show how mental life has earned its right to survive by playing its part in the biological economy. We can approach this part of the program best by seeing how functionalism handles the problems of attention and of imagery.

The Functional View of Attention.—A distant or a confused sound will often result in an animal's pricking up its ear or turning its head in such a way as to favor a better reception of the sound. In other words, the animal attends. It adjusts itself to its environment by seeing to it that one part of the environment is selected out of the rest and given distinct attention. Attention, for the functionalist, therefore, "represents the very heart of conscious activity, its most important center of vitality." Where the mentalist describes differences in the clearness value of sensations, the functionalist sees heightened conscious activity which makes possible a better kind or degree of biological adaptation. No organism can adapt itself at any one moment to the whole of its environment. To respond to everything would so dissipate the energies of a creature that life would be of short duration. It so happens, however, that only a few stimuli are able simultaneously to excite activity in the organism. It is clear that a kind of selection occurs, a selection which seems to imply that some stimuli are more significant than others.

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[1] Read Angell, J. R., *Psychology*, 1904.

The character of a functional account of attention is further illustrated in the description of forms of attention. The descriptive terms "primary," "secondary," and "tertiary," when translated into function become "passive" or "spontaneous," "active" or "voluntary," and "derived" or " non-voluntary." During passive attention the organism is directed or controlled by the suddenness, newness, strangeness, or loudness of the stimulus. For mentalism and for functionalism the facts are the same, but the interpretation is different. The analytical psychologist says, in describing the passive form of attention, that under the conditions mentioned, mind is organized into a high level and a low level, the processes at the high level depending directly upon the stimulus. The functionalist says that the high level marks the point of accommodation, the moment of adaptation. For functionalism, active or voluntary attention "is precisely what the name implies, attention as the result of definitely self-initiated activity." This form of attention comes usually with maturity when the organism is able to entertain two or more possibilities of conduct. That object gets attended to or selected which has behind it the strongest neural excitations. It is accompanied ordinarily by kinæsthetic pressures and strains and by other processes which carry the meaning of effort or concentration. Non-voluntary or derived attention carries with it no actual mental strain or self-direction, and neither do processes set up by an intense stimulus hurl themselves into consciousness. Occasionally we attend to objects because we have attended to them before and they have become a part and parcel of our general intellectual furniture. Biological objects demand attention from a biologist because he has established habits for such objects. He does not attend to them in spite of himself as he attends to a loud noise; and neither does he have to drag them into the field of attentive regard.

Attention is constantly shifting. It knows no resting place. The mentalist or analytical psychologist describes this fact by indicating the rapid change in the processes at the focus of consciousness. The functionalist, however, affirms that "attention is simply a name for the operation of the central, and most active, portion of the field of consciousness"; that "consciousness is an organic function whose intrinsic occupation consists in furthering the adaptive responses of the organism to its life conditions." Adjustments, therefore, must be relatively brief in duration. In so far as "attention is really an activity of the relating, adjusting kind, its work is done when the relation between the mind and the thing attended to is once established. This *is* the mental, as distinct from the physiological part of the adjustment; and attention must go elsewhere, because it is intrinsically the adjusting act itself, and other things are demanding of the organism the same energies of adjustment. To retain our attention for any considerable period an object must, therefore, by changing its aspect, present itself as a new object, to which fresh responses can be made." [1]

A Functional View of Imagery.—A sensation is in no sense an object or event which is yet to happen. An image is not a memory. The ability to anticipate objects does not lie in a neuron. Nevertheless, the organism is an anticipating or prevising organism. This fact will serve to distinguish in still another respect the interests of the analytical psychologist and of the functionalist. It will be recalled that mental analysis discovers images and that one of their chief functions is to provide contexts and so furnish meaning to sensory processes. The functionalist, however, interprets the function of images wholly in biological terms. The organism is endowed at birth with a certain motor equipment which enables it to respond without delay to selected kinds of stimuli. "In seeking to detect the appearance and the function of imagery, we must remember, then, that from the outset of life organic activities are in progress and the sensory-motor activities in particular are in full swing. Each sensory stimulus is producing movements which in turn are productive of fresh sensations. It is out from such a cycle of onward moving coördinations as these, therefore, that the image emerges; and if our previous hypothesis is really adequate to all the facts, it must be that the image is called forth by some need of the organism which the processes that we have already described are incomplete to satisfy. . . . Perception enables its possessor to register in consciousness the particular object momentarily presented to the senses. But if consciousness never advanced beyond the merely perceptual state, it is not apparent that it could serve to develop systematized and intelligent movements of response to environmental demands and opportunities. Intelligent deliberation would be impossible. We should always live in the immediate present, and our minds could consciously look neither backward nor forward. Now it is in the image, with its ability to carry such prospective and retrospective meaning that we find the psychical mechanism for accomplishing both these highly important functions." [1]

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[1] Angell, J. R., *op. cit.*, p. 79.

It was a great day in the history of life, therefore, when the first organism was excited by a stimulus, and responded to it not only in terms of the immediate perception but also in terms of a memory image which told something more about the object than the present situation could possibly tell. The organism that could bring to its aid in imaginal terms a great part of its previous experience had a decided advantage in the struggle for existence over those animals not so fortunately equipped. The difference in intellectual level between man and the lower animals lies at this point. The responses of the human organism differ from those of an amœba in that the responses of the former represent not only the intrinsic tendency to overt action, which belongs to the stimulus itself, but it must also represent and express all the tendencies to movement which remain as the result of yielding to previous excitations. Experience is thus cumulative and the responses of an organism are constantly being made at higher and higher levels.

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[1] Angell, *op. cit.*, pp. 176–177.

Functional psychology laid its hands upon some extremely important problems; but its program was hampered by the fact that it attempted to reconcile the classical analytical psychology with biological concepts rather than, by working from within, seeing that the starting point of psychology must be changed before a reconciliation could be effected. The analytical psychology was built upon a pre-Darwinian foundation. The attempt to biologize the facts that came from the first laboratories was instructive and alluring; but it could not be convincing until the foundations of psychology itself were biologized. What this means we have seen in the first chapter.

Purpose in Behavior.—Dynamic psychology has not found its primary usefulness in abnormal psychology. As a purposive psychology it has been raised almost to the rank of a psychological system by McDougall.[1] In reviewing a large number of experimental studies on human and animal behavior, McDougall was lead to a number of "marks of behavior," among which we may mention the following. (*a*) There is a certain spontaneity about the movements of all living creatures. Animals are not pushed or pulled by a stimulus but meet the stimulus more than halfway. (*b*) Then there is a *persistance of activity* which is independent of the continuance of the stimulus which sets off the movement. (*c*) Inanimate objects also persist in movement after the exciting agent has disappeared, but in this persistence of animal movement there is constant *variation of direction.* (*d*) It must not be thought, however, that variation of direction continues indefinitely. As a matter of fact, in all living creatures the variation, even the persistance of the movement, ceases as soon as they have brought about a peculiar kind of change in the situation of which the behavior is an integral part. (*e*) There is also a kind of animal behavior in which the animal reacts or moves with respect to an event that has not yet occurred. It even happens that the present behavior contributes to the creation of the new situation which is in the process of formation. (*f*) There is, finally, the fact that animal behavior tends to become more effective under repetition. There is experimental justification for the fact that all of the higher animals at least profit from past experience.

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[1] Read McDougall, W., *Outline of Psychology*, 1923.

Now if we ask what all these marks of behavior mean, says McDougall, we see that they can mean only one thing, viz., that behavior is purposive. Thus purposiveness in this sense "seems to be of the essence of mental activity." It is not reflexes that are purposive nor single reactions of single muscle groups, but behavior; the total reactions of a living creature appear to be determined by ends to be gained. This purposive total reaction of an organism is thus raised to the seventh and the crowning mark of behavior.

Dynamism has a great deal to commend it for it throws emphasis upon a type of mental life and behavior that would otherwise stand neglected. As a system of psychology it has to show, however, that the so-called dynamic phases of behavior and of mental life are due to active mental processes or to an active *mind* rather than to an active, even energetic, nervous system. Up to the present time it has not succeeded in doing this.

Behaviorism

Prior to Darwin, zoölogy had been as much of a game as a science, a game of classification, a sort of competition in which the prize went to that naturalist who could make the most orderly list of all living forms. Linnæus won the prize. The task was to gain as complete a static description of all living forms as could be gained and then, sorting animals with respect to likenesses and differences, to classify the whole in as orderly a way as possible. After Darwin men viewed classification as incidental to other problems, incidental to function and to the interrelatedness of animals. Living creatures no longer appeared as discrete entities but as members of a family. Naturalists turned from pigeonholes to the evolution of pigeons,—to the evolution of all living creatures. Man became an animal and animals became prophetic of men. One might as well try to classify a sunrise as to classify a dynamic, onward-moving flood of life.

Animal Psychology.—We now look with interest and amusement upon the serious arguments which men have had over the question as to whether animals have souls or not. He who could muster the most anecdotes about animal behavior usually won the argument. As in the case with human beings, no one seemed to think that it would be worth while to experiment upon the matter. Consequently animal psychology was slow in getting under way. The Wundtian psychology offered but a scant incentive to make such studies, for the animal could not make verbal reports about its experiences, *i.e.*, it could not introspect. The description of the mental life of animals became a sort of game for philosophers, a game during which one attempted to fit as many mental elements into the mind of the animal as the complexity of its nervous system, the perfection of its sense organs, or its relative position in the animal scale made advisable.

Shortly men began to see that the approach to a psychology of the lower animals lay through a study of *animal behavior* and not through speculations about their mental life. The problem was not, What kind of mental life does the animal in question enjoy? but, How does the creature behave, what does it do? An increasing number of serious questions were directed toward the experimental situations into which animals may be placed and toward the adjustments which the animal is able to make to these situations.

Darwin had seen some of the problems which might fall under the topic "Animal Psychology," but at the same time he had unwittingly opened the floodgates of anecdote about animal life and behavior. Under the sobering influence of a few experimenters like Loeb, C. Lloyd Morgan, Jennings, and Thorndike, however, the experimental study of animal life gradually came into its own. Loeb and Jennings confined their work to the lower forms of life, the former inventing a mechanics of animal behavior by explaining all the movements of the lower forms of life (and ultimately, the higher forms as well) as "tropisms" (see p. 199), while the latter gave significant moment to moment descriptions of the hourly life and behavior of the amœba and related protozoa.

In addition to a large number of experimental studies on animal behavior, especially in the field of instinct, we owe to Morgan a canon which has come to be known as the *principle of parsimony.* This canon reads: In no case may we interpret an action as the outcome of the exercise of a higher psychical faculty, if it can be interpreted as the outcome of the exercise of one which stands lower in the psychological scale. At the time of its pronouncement, this canon exercised an extraordinary significance because the anecdotal type of psychologizing was at the height of its influence when Morgan began his work.

Thorndike was the first to introduce into the modern psychological laboratory those methods and some of the pieces of apparatus which have, since then, been so fruitful in the whole field. Morgan may be called the father of comparative psychology but Thorndike may be fittingly called the founder of experimental animal psychology.

Subsequent to the tremendous growth of interest in animal behavior and because of the influence of the doctrine of evolution men began to ask, more and more frequently, the following pertinent question: How far may one go in writing a *behavioristic* account of all animals, *including the human animal?* The force of this question was augmented because men were becoming more and more dissatisfied with the arid analytical descriptions of the mentalists and with the program of experimental psychology in general. It was said that the analysis of mental life did not reveal the essential facts about mental life. To this was added the contention that the analysis and description of mental life tells nothing at all of the process by which animals, including the human animal, get on in their environments. Moreover, commerce and industry, education and medicine, could find no comfort in critical inspections of the quality and properties of a sensation or an image. The person who is addressed by an advertisement is not a sensation or a bundle of sensations but a living human being reacting in certain ways to the situations which confront him. What we must know, therefore, about him is not the attributive peculiarities of his sensations but the nature of his reactions.

Objective Psychology.—As a result of these and other factors, the last decade has seen the development of an objective psychology of human beings commensurate with the objective psychology of the lower animals. This psychology is known as behaviorism. The creed of the behaviorist runs somewhat as follows: I believe that the nervous system of all animals, including man, is a cunningly devised connecting system interpolated between the receptors (sense organs), on the one hand, and the effectors (muscles and glands), on the other, and that the lifelong activities of all animals can be accounted for in terms of what happens in the receptor (under excitation from some stimulus or from some stimulus pattern), in the great central adjustor (the brain), and particularly in the muscles and glands. I believe that the foundation of all behavior is the reflex arc and that complex modes of reaction to a stimulus are complexes of reflex arcs. I believe that the nervous system is a mechanical system which is sufficient unto itself and that our final explanation of its activities is to be found in a chemical study of the processes of metabolism that go on within the system.[1]

The Behavioristic Account of Thinking.—Following our previous practice we may illustrate behaviorism and its program by showing how it treats a crucial problem. We choose the problem of thinking. If we are to believe the traditional psychologies, thinking is a process that has little, if anything, to do with reflex arcs and with muscular movements. But it is also true that thinking appears to have little in common with sensations, images, and simple feelings; for the mentalist was not long in discovering that the number and range of mental processes was wholly inadequate to the richness and complexity of the problems solved. Moreover, there was nothing in the mental elements to give a suggestion as to why a problem moved toward a solution. In order to explain the fact that only those ideas appeared which were most relevant to the problem, the mentalist went to the nervous system and found there, so he said, determining tendencies or drifts. It was these tendencies which caused the problem to move toward its solution.

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[1] Read Watson, J. B., *Psychology from the Standpoint of the Behaviorist*, 1924. *Behaviorism*, 1924.

The behaviorist found little comfort in this procedure. Thinking, for him, became a problem of muscular movement. Thinking was distinguished from other forms of behavior, that is, from other forms of reaction to a stimulus, by the fact that it makes use of language or verbal responses rather than of the rougher manual responses. In other words, thinking is laryngeal action. Words may not actually be uttered, but one may find, nevertheless, incipient tendencies to speech which are enough to carry out the solution of the problem. We shall return to this program of the behaviorist on p. 225.

Comments on Behaviorism.—The general comment of the behaviorist on analytical psychology was that it amounted to nothing. It was alleged that mentalism had no practical meaning in the life which men actually lived. Life demands action and what counts is action. The study of behavior, therefore, offered itself as a scientific study of that aspect of living which counts. Moreover, it has been said over and over again that the analytical psychology is arid, that it takes a rich, warm, pulsating mental life and makes an uninteresting morphology out of it. This somewhat emotional argument has carried a great deal of weight in the popular mind. It is safer to rest upon the sounder and more significant criticisms of the gestalt psychology. The analytical psychology found joy in *items*, the gestalt psychology finds joy in *configurations*, in the unique qualities of wholes, in the totality which *is* mental life.

Behaviorism, which meant to correct some, if not all, of the evils of the classical psychology, has missed the same point about behavior which mentalism missed about mental life. It has missed the point about reaction patterns which the gestalt psychology has meant to emphasize. The first search of the behaviorist was for units of behavior and what he found was reflexes. The stream of behavior then became a complex of reflexes just as the stream of consciousness had been spoken of as a complex of sensations. If we repeat, then, a thought which has already been expressed on p. 107 we shall be facing one of the main problems of contemporary psychology. The thought is this: Does a penetrating analysis of an event or object open the way to a deep *understanding* of the event or object? This is, perhaps, one of the most fundamental questions which psychology will have to answer in the future.

Summary.—Many of the statements of fact and the formulæ of science assume a point of reference or a system of coördinates with respect to which the facts and the formulæ are held to be true or valid. Thus in geometry the position and the movement of a point or the properties of a curve are fully determined as soon as a suitable system of coördinates has been selected. The Boyle-Mariotte Law (a formula which expresses the relationship between volume, pressure and temperature in a gas) is frequently expressed in terms of a temperature scale based upon the freezing point of water. The coördinate system or the temperature scale have nothing to do either with the nature of the curve or with the relation between pressure, temperature, and volume save that a point of reference makes proper description easier.

It would be a great thing for psychology if it, too, could find a point of reference (a point of view) or a single system of coördinates with respect to which it could describe all of its facts; but up to the present time no such happy discovery has been made. All of the points of view or the points of reference which psychology has hitherto used are inadequate in the sense that a change in point of view changes the intrinsic nature of the materials being described. A curve retains its intrinsic properties no matter from what system of coördinates it is being viewed. The survey of the schools of psychology we have just made shows that psychology, on the contrary, has changed its whole complexion with every change of perspective. There are psychologists who believe that this must always remain so, that the science must always sway back and forth between mind and body, that the laboratory can never overcome or avoid the dualism of nature. On the other hand, an increasing number of psychologists believe that a suitable "system of coordinates" for psychology can be found in biology. This was the view of Chapter I. Since much of that chapter hinged upon talents of nervous systems we must now go to them and find out just what they have to offer.

CHAPTER IV

EXPLANATORY PRINCIPLES IN PSYCHOLOGY

Like every other man of science, the psychologist finds himself curious about "the reason why." Why do some creatures have a wider effective environment than others? Why do some events in the environment become determining factors in the behavior of a creature to the exclusion of other events? Why do animals look into the future by preparing now for an event that has not yet come to pass? Why and how do animals draw upon their past for aid in the present? In short, how can intelligence be explained or accounted for? This question is probably of more importance to the psychologist today than it will be fifty years from now, for explanatory psychology has played an unusually large rôle in the past in determining the problems of psychology and confusing the vision which men have had of their task.

Explanatory principles in psychology come from three sources, viz., from animism, from philosophy, and from scientific inference. The inferences may be drawn either from psychological facts or—and this is more usual—from related sciences.

The Soul.—When we think about psychological problems in the animistic way we naïvely attribute our intellectual power or the intellectual power of another individual to an indwelling soul, and thus the whole matter is ended. A history of the events by which we have come to the concept of a soul would fill a very large book and we shall attempt, therefore, not even a summary of them. It becomes pertinent to remark, however, that the concept does have a history and that the notions men have had about the soul have evolved just as their notions about many another object have evolved. That is, the idea of a soul has not come from the direct observations of souls but from a gradually developing concept of what a soul must be like if it is to explain the events which stand open to explanation.

Opinions and beliefs about the soul may vary all the way from the crude materialistic conceptions of the ignorant to the most abstruse metaphysical treatises of the theologian and philosopher; but in any case, all psychological problems can readily be solved by the plain assurance that the soul has talents adequate to account for every type or degree of intelligence to be found in man or animal. It is in this same way that men used to explain all the phenomena of life by assuming that reproduction, digestion, cell division, respiration, and the like were due to a living principle. It is in this way that the man on the street explains an unusual event by saying that it is psychological. He uses a word and that settles the matter.

The use of the *soul* as an explanatory principle has the advantage that it is simple. A phenomenon is observed, a law of learning discovered, the fact of memory is described, and the refrain is added: the soul works in these ways. No plan is suggested by which learning or memory or any other phase of intelligent behavior can be controlled.

Inadequacy of Animism.—We have space to mention only three difficulties which stand in the way of using the soul as an explanatory principle. The first is that we add nothing to science by introducing a name. We do observe animals at work and at play in their respective environments; and we have not helped ourselves when we have appealed to an unobserved, unknowable force or agency which, by its very properties and attributes, severs itself from the observable facts at hand. In the second place, this explanatory principle proposes no experimental problems, gives us no further leverage on the unknown. It is a plain invitation to further speculation instead of to further experimentation. It is characteristic of all the explanatory principles used elsewhere in science that they suggest further research, they lead to the formulation of new questions, they become experimentally productive. In the third place, a soul psychology can do nothing with some of the facts that we observe,—multiple personality, for example. In advanced cases, only the most careful analysis will show which of several personalities is fundamental. It is humorous to suppose that an individual may, for a time, offer hospitality to two or more souls. Moreover, it is not sufficient to explain such cases by appealing to evil spirits and to demon possession. There is only one way for psychology to stand upon a practical or useful level with the other sciences and that way is the laboratory way.

Psychology has not found it useful to appeal to a soul and illogical thinkers have thus drawn the conclusion that psychology has thereby passed final judgment upon the matter to the effect that souls do not exist. This, perhaps, is a question upon which psychology is not yet competent to pass judgment.

Rational Psychology.—The philosophical way of handling the problems of psychology is also easy, at the start, but subsequent progress is made only over rough and stony paths. Men were philosophers because they thought they could think. And having found that they could think it was natural that, along with the many other talents of human beings, they should think about thinking. Whether the philosophers believed that they themselves really thought or whether their souls or the thinking principle within them did the reasoning does not concern us here. The point is that in all philosophizing it was and is assumed that reasoning is the queen of all the human talents, that the products of reasoning are authoritative.

Rational psychology has a slight advantage over animism because most philosophers begin their reasoning with a few observed facts or with a few assumptions suggested by the facts. We thus satisfy a little better our natural human hunger for explanations. In animistic thinking we either ignorantly or piously cast our burdens upon the soul. In philosophical thinking we make some attempt to exert ourselves intellectually and get behind the facts. Thus philosophical systems arise, systems which are beautiful in their symmetry and splendid in their logic; but even systems do not satisfy our thirst for knowledge. Systems stand or fall as assumptions stand or fall, and when they have fallen often enough men begin again to wonder.

This was the experience which men suffered shortly after the middle of the last century. Kant meant to write not only the foundations for any future metaphysics, but to make good progress toward a definitive and final philosophy. Within fifty years after the death of Kant, philosophy stood in greater disrepute than ever before in her history. This was true, not only because philosophy had failed but because science was succeeding. Philosophy has once more found its place in the counsels of men but with changed habits and attitudes, since less regard is now had for systems and more for broad points of view which will correlate and put cosmic meaning into the several branches of science.

Explanatory Principles Derived from Scientific Researches

The soul psychology failed, not because it was proved that there was no soul, but because the concept was not found useful in the experimental study of mental life and of behavior. Rational psychology failed because it assumed the noetic sanctity of reasoning. We now have to consider some of the principles of explanation which science itself has derived. We shall find that even science has used theological and philosophical methods and has, thereby, also made failures. On the other hand, a few scientific inferences and guesses have proven useful.

Scientific Authority.—In this connection it will be helpful to the reader if he will constantly remind himself of the fact that men may be provincial in time as well as in place. We live and have lived for three hundred years in a scientific age. We have grown accustomed to the meaning of scientific progress and we have learned to think of science as speaking with the voice of authority. We know also that science has made its best progress while thinking in terms of mechanics. Materialistic philosophies were never so strong as they were during the last half of the last century. Psychology, too, is under this tradition and under this culture. It is tacitly assumed in many quarters that explanatory principles are not scientific unless they are mechanical or unless they conform to what we call the natural universe.

It must be admitted, moreover, that there are many problems which science, and especially psychological science, has not been able to solve. At least there is, at the present time, no acceptable method of approach to certain problems. The suggestion is often made, especially to psychologists, that modern science, by virtue of its methods, because of its laboratories, because of the use of apparatus, and particularly because of its assumption of a natural universe, may not be in a position to ask intelligent questions about the whole of nature. Parapsychology, or the science of occult phenomena, asserts this. Philosophy asserts it. Sometimes psychology asserts it. It is a problem we face whenever we consider the higher forms of *mental life.* We have seen how a physiological psychology can ask certain questions about the course of certain mental events; but those who insist that such investigation does not strike at the very heart and meaning of *mental life* may be right.

Sources of Explanatory Principles.—Scientific inferences as to the controlling and directing agencies in intelligent behavior derive, as a matter of course, from two sources, viz., from mental life itself and from the physiological escorts of mental life (not to say conditions, causes, substrata, and the like). When Wundt said that psychology was to be a science of experience as dependent upon the experiencing individual (and hence that it was to consist mainly of the description of items), he was forced to leave out of account much that had formerly been attributed to dynamic agents. Wundt's students went even further in this direction than did the master and the result was the elimination of almost every vestige of agency or power save as these were found in the nervous system.

Such an outcome was hardly satisfactory, especially in view of the obvious vectorial nature of a great deal of mental life, and men were obliged to search for dynamic and directive agents either in the nervous system and in the bodily energies or in new conceptions of the nature of mental life. Most of the experimental psychologists did the former while medical men, a few psychologists, and a great many philosophers took the second path.

All of these things we must remember as we proceed to a discussion of the explanatory principles which have been derived from within the field of research itself for the explanation of all the phenomena of intelligent behavior. We shall not consider again either functionalism or dynamism as ways of accounting for the organization of mental life. That is, we shall not consider them again until we have seen what the nervous system itself has to offer. Neither shall we consider the subconscious at this time. We shall, however, have to devote a special chapter to it at the end of the section on abnormal psychology.

"Mind" and "Mental Life."—We refer again here to a distinction that has already been drawn between the meanings assigned to the phrase "mental life" and to the phrase "The Mind." In the traditional psychology, Mind was thought of as an agency, a thing (say, a soul), and it was this *thing* that moved the nervous system, or stepped in at crucial moments and turned the switches. In still earlier times, the brain or the brain cavity was merely the residence of the soul. The changes which Wundt introduced into psychology meant that it was better to speak of experiences which go on, which run their several courses, than to speak of a soul or of a Mind. This change in point of view which was introduced by Wundt made a scientific psychology possible, but it also raised the question as to whether experience was not something that accompanied or went along with those operations which enable living creatures to create an environment and get along in it.

Because of the fact that so many people use the phrase "Mind" in somewhat the original sense, that is, use it as a name for an agency or power or dynamic force (other than the energies of the body and of the nervous system), it seems best to retain the word for this purpose. The phrase "mental life," on the other hand, we shall use whenever we mean to think of that series of conscious processes which are subsumed under the word "experience."

The "Reality" of Mental Life.—The redness which I experience when the sun sinks low on the horizon is not a neuron or any series of neurons. Neither is it the hypothetical ether vibrations of which the physicist speaks. As I close my eyes later in the evening the redness is still "there." A year later I recall the beautiful sunset and still the redness is "there." The visions which I experience in my dreams, the crisp odor of a late Fall day which I experience in November, are not physics or physiology. The scanty and often unrelated and irrelevant images that course their way in the stream of consciousness as I attempt to think are not "nothing."

Mental life does go on. This is a natural fact. The great psychological question about mental life is: What does it mean?

Mental Life as an Explanatory Principle.—The use of mental life as an explanatory principle in psychology depends upon how psychology means to solve the mind-body problems. Wundt solved them by a subterfuge (p. 70). That is, he used a subterfuge to open the way to an experimental psychology of the lower types of mental life. But the doctrine of psychophysical parallelism could never solve any problems. It only postponed the day when psychologists would have to recognize the joke they had played upon themselves and grapple with the problem all over again.

Of the "reality" of mental life there can be no doubt. The important question is: What difference does it make? We cannot be satisfied with the answer of the Darwinian that it *must* make some difference, since otherwise it would not have survived. There are dozens of places in evolution where Nature had large plans and their fulfillment meant the appearance of structures and functions which, in and of themselves, might have had no biological significance. We are now far enough away from Darwinism to see that the doctrine of survival value was driven a little too hard. It is just as easy to think that life was working toward an increasingly effective nervous system as toward an autonomous mental life. The presence of what we call mental life may be an incident in the development of something more important and more effective, viz., a capable nervous system.

The Principle of Psychophysical Conjunction.—Mental processes are not believed to exist apart from nervous systems. Mental life cannot be conceived of apart from an appropriate neural basis. Evidence for this proposition comes from the man on the street as well as from the man of science in the laboratory. Let us remind ourselves of a part of the evidence.

Consciousness ceases under a blow upon the head or upon other concussion of the brain. Some drugs heighten consciousness, others make it duller, or cause it wholly to disappear. In sleep, when the functions of the brain as well as many of those of the body may be thought of as in abeyance, consciousness almost, if not quite, disappears. In general, the size of the cerebrum bears a fairly close relation, as between different orders of vertebrates, to the apparent intelligence of an animal. The ability of an organism to profit from past experience appears to depend upon the size and development of what is known as the new brain.

These are facts known and discussed by the man on the street. Science supports and extends them. Mental activity is known to be closely related to the supply of oxygen sent to the brain, and stopping either or both of the large arteries supplying the cranial cavity results in profound disturbances and finally in cessation of consciousness. Excessive mental activity increases the temperature of the brain and the amount of waste material excreted, just as if the brain obeyed the same chemical laws as do the muscles. It has been found over and over again that wounds to brain tissue or tumors, and blood clots in the brain, eliminate certain definable types of mental life, types which are always associated with distinctive brain areas. All of the sensations are immediately dependent upon processes in the sense organs, and visual sensations are known to depend upon chemical changes in the retina following excessive stimulation.

All of these facts may be summarized and expressed in a principle known as the principle of *psychophysical conjunction.* This principle means that mental life in all of its forms depends in some unknown way upon correlative brain processes. It means that no one has ever observed or found evidence for mental processes occurring independently of or spatially removed from a nervous system within a living body. It means, also, that while mental processes depend absolutely upon nervous processes, not all nervous processes are accompanied by mental life. Many of the movements of the human body, for example, initiated and maintained by the nervous system (heart action, digestion, certain types of reflexes, automatized or habitualized movements, etc.) are accompanied either by no mental life whatsoever, or by mental life irrelevant to the bodily function concerned. In thinking, to take an extreme case, the amount of mental process is absolutely out of proportion to the problems that are solved. Sometimes they are even irrelevant. And as often as not, the cleverest solutions to the most difficult problems appear to have no mental correlate at all. We gaze dejectedly at our formulæ or at our data and suddenly the "hunch" comes.

Theories of Mind-body Relationship.—The principle of psychophysical conjunction, that is, the statement of fact that mental life is always found in immediate dependence upon brain function, does not tell us just how the relationship may be thought of. There are four such theories, viz., the doctrine of psychophysical parallelism, the doctrine of epiphenominalism, the doctrine of interactionism and the double-aspect theory.

Psychophysical parallelism thinks of the brain and of mental life as two independent series of events, each complete in and of itself, but each timed so nicely that the two events always run parallel with one another. Who established the preëstablished harmony between the two series of events, or how such a harmony came into existence has not been shown. Epiphenomenalism assumes that the brain events are primary events and that the mental events are related to them as a secretion is related to its secretory organ or as the tail is related to the comet. Interactionism, like parallelism, assumes the reality of two orders of events, the mental and the physical, but asserts that the two interact with one another, bodily events bringing about changes in mental life and the energy of mental life manifesting itself through modes of action in the body. The double-aspect theory assumes that there is only one reality, neither mental nor physical, a reality which from one point of view comes to us as mental and from another point of view as physical. The same lens, for example, may be described as both concave and convex.

The Meaning of Mind-Body Theories.—We derive the following generalizations from the principle of psychophysical conjunction and from the theories of psychophysical relationship. (*a*) Of the series of phenomena, the physical and the mental, the former appears to be the more extensive and inclusive so far as the facts of intelligent behavior and living are concerned. The body continues its functions, many of them skillful, under total or almost total lapse of consciousness, as in habit or in constructive dreaming. A physician, after a hard day's labor, goes to sleep and during the night, when called upon again, performs his operation without remembering the next morning that he has been awake. (*b*) Where consciousness is present, say in thinking, it seems wholly inadequate or insufficient to account for the conclusions that may issue from the period of reflection. Often, as a matter of fact, the mental material appears quiet irrelevant to the process of thinking. Psychologists of a dozen years ago, for example, were distressed over what was called "imageless thinking," that is, thinking where there were no mental processes to act as a vehicle for the thought processes. (*c*) All of the theories of mind-body relation either take for granted or tacitly assume the proposition that the nervous system and particularly the brain is, as a matter of fact, capable in and of itself of performing all of the functions necessary for the production of intelligent behavior. In psychophysical parallelism, for example, the brain events are assumed to be as complete and as adequate as the mental events. Otherwise there could be no parallelism. Epiphenomenalism assumes that the brain events are as much more fundamental and adequate than the mental events as a wave is more fundamental and real than the foam and spray. Interactionism assumes a brain event adequate to cause an equivalent mental event, and the mental events must produce a brain event adequate to call for a response commensurate with the original intent of the mental event. And finally, if brain event and mental event are two sides of the same reality we have no ground for supposing that one side is more or less adequate than the other.

In other words, we face the plain fact that in our theories we have assumed that the nervous system is adequate to all that appears in the way of intelligent behavior. This fact has not been very comforting to some because they feel that we are lowering mental life to a more or less mechanical level. It becomes a little more comforting, perhaps even enticing, if we are willing to raise the level of the nervous system to the level of intelligent behavior. For the most part, this means having a little more reverence for a very wonderful instrument. Just how wonderful it is may appear within the course of the next few pages.

In the meantime we have not answered the question as to what the psychologist shall do with consciousness. We have not indicated where it belongs in the systematic arrangements of his facts. Two considerations are involved in the answer to these questions, viz., (*a*) What is the nature of the psychophysical experiment? and (*b*) What is the nature of the report in other psychological experiments?

What is Measured in Psychophysics?—Fechner, it will be recalled, thought that in his experiments he was measuring the intensity of something mental. By varying the intensity of the stimulus used in the experimental setting he was able to gain from an observer the report that one sensation was just noticeably different in intensity from a second. We have no space in which to consider the many discussions and disagreements which the Fechnerian experiments raised, but we now see that Fechner was not measuring the intensity of a sensation at all; he was measuring the talent of an individual to make discriminatory reactions. What he discovered was that a stimulus could be varied in intensity or even in quality without exciting either a verbal or manual response different from the preceding response. He determined the limits of change in the experimental situation which would just excite a different response.

Let us say that an artist owes his success to his ability to make careful discriminations in the selection of his pigments. We do not assume that his painting is in any sense of the word a measure of qualities of sensation, of redness, blueness, and the like. We say rather that his painting is a measure of his powers of visual discrimination. Were we to take him into the laboratory and ask him to do under controlled conditions what he does in his studio, we should have a psychophysical experiment of the Fechnerian type.

An enormous amount of psychological measurement, perhaps all such measurement, is thus a measure of perceptual talent rather than a measure of mental process. Likewise among the lower animals we should speak of degrees of talent rather than measures of mental processes which are assumed to compose the mind of the animal. And the talents that are measured are not mental talents or mental faculties. They are talents which owe their existence to the structure and function of sense organs, nervous systems, and motor organs, to the *nature* of living creatures. This will become clearer in the next few pages.

What is the Meaning of Introspective Reports?—In a typical introspection it is alleged that the observer or the subject in the experiment is making a direct report of his own mental life. It is as if he, the observer, with motor mechanism leading to his own vocal cords, were observing as a spectator a realm of mental events quite detached from the nervous system of which he is the possessor.

An introspection is, of course, a verbal report. It is a mode of response which is given as a result of the experimental situation, and as a result of the distinct instruction to make a verbal report. The experimenter does not compare the mental process reported on by subject A with the mental process reported on by subject B. He compares reports themselves. He tabulates the verbal responses whether they be in one or a hundred words. Psychology, said to be the science of mind, has no mental data. It has only bodily responses, either verbal or manual, or measures of contraction from the gross musculature. This is a portentous fact and psychologists are in wide disagreement with one another as to just what it means. As we have already seen, it furnishes at least one of the marks of separation between mentalism and behaviorism.

Introspection as a Method of Neurological Research.—A physician almost always begins his diagnosis of an ailment by gaining a report from the patient. This report, which speaks of pains in various members of the body, of shortness of breath, of dizziness or what not, is a rough introspection. The physician takes the introspection, that is, the recital of the symptoms, for what it is, viz., a secondhand method of applying his knife and his microscope to the internal organs and tissues of the patient.

We have here a suggestion of the way in which introspection may be used to unfathom typical modes of operation of the nervous system. We recite two or three instances. The type of psychologizing which came to be known as English Associationism rested upon a principle of association which was discovered, not by knowing how the nervous system works, but by observing the uniformities that appear in the stream of mental life. The English associationists said that ideas which resemble one another or ideas which have once appeared together in mental life tend to appear together again. A more critical psychology translated this law of association into the words: Mental processes which have appeared together in consciousness tend to appear together again. The physiological psychologist says, in turn: Whenever any two neural processes have occurred together they tend to occur together again.

We may take another illustration from the psychology of the thought processes. After a period of suitable experimentation it was discovered that the elementary processes discovered up to that time were not adequate to a description of thinking in mentalistic terms. Some experimenters said they had discovered a new element, the thought element. No one was able to render a convincing account of the fact that in thinking the organism is always solving a problem. The analytical study of thinking was bolstered up by an appeal to a problem-solving tendency or a determining tendency, a directive something in the nervous system which brought the organism forward in a suitable way toward the solution of its difficulties. Thus an introspective examination of thinking became prophetic of types of neural integration which were unapproachable by direct neurological methods.

The two examples we have given relate to integration. Examples of other types are numerous. The discovery of receptors in the skin for the mediation of touch sensations followed introspective accounts of the definite and unique quality of these sensations. The introspective accounts of visual and auditory phenomena have always been as suggestive as histological research when men have come to the formulation of theories of vision and hearing.

Introspective reports have also proven their usefulness in studies on the localization of function in the brain and especially upon the nature of the associations that may be established between these centers. Gelb and Goldstein, the one a physiologist or neurologist and the other a psychologist, used the method constantly in studying the course of cerebral injuries that were caused by shellfire in the Great War. Reports on curious alterations in the perceptions of objects were used as a means of diagnosis of cerebral destruction and in the mapping of cortical areas that were directly concerned in the perceptual talents being studied. These and similar studies have thrown as much light upon the nature of nervous functioning as have some of the most penetrating histological examinations.

It is the plain testimony, then, of current research and current theorizing that if we knew all that we might know (all that we may even expect to know) about the nervous system and its modes of operation we should be a long way ahead on the road toward understanding and controlling human conduct. Mental life, there is; but all that we may say about it reflects back upon the instrument which is directly concerned in its production. What is this instrument of which so much is promised and what are its modes of operation?

Explanatory Principles Derived from Modes of Operation of the Nervous System

Almost all experimental psychologists have gone at one time or another to the nervous system for principles of explanation, whether it be of simple mental process or of the most complex forms of thinking. The analytical psychologist, for example, makes much use of habituational tendencies, determining tendencies, associative tendencies, and problem-bearing tendencies. This appeal to the nervous system is at one and the same time an admission of the complete adequacy of the nervous system to account for intellectual talent and a complete misjudgment of what it means to explain. Nothing is added to the older psychology when one says that a given type of mental organization owes its origin to an associative tendency in the nervous system. Of course it does! The problem is: How are associative tendencies created? What principles of nervous structure and function admit of the possibility of erecting a problem-solving tendency? The great question is not whether the nervous system is adequate to condition all types of mental life but whether the nervous system is adequate to explain intelligence in all of its forms or moments. The consciousness had by the subject in the experiment is a sign of something that is taking place in the nervous system, a something which needs to be explained. Why the consciousness itself should accompany the nervous activity is a question which is not explained, and perhaps does not need to be explained.

The Functions of the Nervous System.—In addition to falling over when struck or dropping when unsupported (as a result of the laws of mechanics which apply to the movements of any sizable mass) living beings *respond* to *stimuli*. Organisms are so built that energy acting upon one part of the body can (at least in the higher organisms which possess genuine nervous systems) be conducted to another part where it will be transformed into muscular work of contraction. We have already had plenty of illustrations of what this means, but now we must greatly simplify the picture by asking what takes place in nervous systems when adjustments are being made. We begin with the definition of the two words, stimulus and response.[1]

Stimulus.—The word stimulus has two meanings. In the first place, any object or event whatsoever becomes a stimulus when it can be demonstrated that it is effective in calling forth some sort of adjustment in an organism. The objects and events which are referred to when we speak the words red paper, vibrating tuning fork, sugar, horse race, sunrise, are stimuli for most human beings. It is obvious that these objects do not belong to the environment of all animals.

The word stimulus, when used in the above sense, does not always mean a single object or event. Dozens of such stimuli may be acting upon an organism at one and the same time. In such a case we may say that the organism is confronted by a situation. The situation is a total mass of stimulating objects or events which, taken as a whole, earn for themselves a definite reaction. Thus all psychological experimentation involves the setting up of an experimental situation, a situation which is comparatively simple and which can be controlled in most, if not all, of its parts. It is not probable that a single stimulus ever earns for itself alone a reaction.

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[1] Read Herrick, C. J., *Neurological Foundations of Animal Behavior*, 1924. Child, C. M., *Physiological Foundations of Behavior*, 1924.

The second use of the word stimulus derives from physics and physiology. Here it denotes such events as ether vibrations (light rays) of various wave lengths, sound waves (vibrations of the air) differing in amplitude, length, and number per second, gaseous and liquid substances with a molecular vibration adequate to the excitation of membranes in the nose or in the taste buds upon the surface of the tongue, solid objects which move against or rest upon the skin and mucous membranes, objects giving off heat or absorbing heat, and all objects which cut, prick, tear, or injure in any other way the nervous substance.

On the face of it the relation between the common sense and the physical or physiological notion of stimulus is obvious. The man on the street remarks of the sunset that it is beautiful. The physicist remarks of the sunset that an unusual number and pattern of light waves is being refracted from the sinking sun through the droplets of vapor in the air. The sunset does not bodily leap into the eye of the man on the street and stimulate his nervous system to the verbal response "beautiful"; a pattern of ether waves does, however, literally make this leap.

It is obvious that the two meanings of the word stimulus which we have just illustrated do not raise a fundamental methodological difficulty. The human experimenter places a piece of red paper before his subject with the expectation of getting some verbal or muscular response. We know of course that the paper does not fly into the eye of the subject and thereby induce the response. The physicist tells us that the paper and the eye are bound together by ether waves which are reflected from the paper. We may evade, therefore, the difficult theoretical question as to what the relation is between ether waves and a piece of red paper. The same relation holds between other stimulating objects or events and corresponding types of physical energy; but in laboratory practice this theoretical question is of little concern.

The world of nature which physics and chemistry present for consideration is obviously not the world we see and hear and feel and touch. The world of physics is a world of energy in different form, a world of electrons and protons. This book, as you hold it, appears to you as a book; but, as a matter of fact, you are holding a mass of electrons and protons and its appearance is due to the ether waves emitted by or reflected from the items of which the book is constituted. Every inquiring soul would like to know how ether waves and other forms of energy are translated into objects and events. As we have suggested, we do not have to solve this problem before we proceed with scientific research; but we are puzzled by it nevertheless. We shall consider it again in Chapters VI and VII for it must be clear to everyone that the history or evolution of our sense organs and brains should reveal something about the origins of knowledge.

The Receptors.—In order to understand fully the nature of the stimulus-response talents of the human body it is necessary to review in considerable detail the structures which make such talent possible. These structures are the receptors, the effectors, and the great central adjustor with its subsidiary parts. These three structures owe their functions to three properties of all living substance, viz., sensitivity, contractility, and conductivity. In the course of racial or of individual development certain cells become specialists in the art of reception, others in the art of conduction, and still others in the art of contraction. Many of the cells of a complex organism have given up their original functions of sensitivity or of irritability and have devoted themselves to the manufacture of a hard rind or covering for the softer tissues underneath.

Those organized groups of cells which have become specialists in the art of reception may allow entrance into the body of only one form of energy. Thus we find that during the course of evolution one receptor has become particularly sensitive to mechanical contact, another to periodic vibratory movement in the air, another to similar movements in the ether, and another to changes in the molecular movement of solid objects; but in spite of all these provisions for the inlet of energy into the nervous system, there are many forms of energy which do not belong to the environment of any creature that we know anything about. "We may conceive the body as immersed in a world full of energy manifestations of diverse sorts, but more or less completely isolated from the play of these cosmic forces by an impervious cuticle. The bodily surface, however, is permeable in some places to these environing forces and in a differential fashion, one part responding to a particular series of vibrations, another part to a different series, much as the strings of a piano, when the dampers are lifted, will vibrate sympathetically each to its own tone when a musical production is played upon a neighboring instrument." [1]

In the process of development accessory organs and structures arise which aid in directing the energy of the stimulating agent upon the receptor, so increasing the mechanical perfection of the apparatus. The eye, for example, contains receptors sensitive primarily to a rather limited number of ether vibrations (one octave out of over fifty) and it is so arranged mechanically (a series of refracting surfaces) that rays of light impinging upon its outer surface may be brought to a focus upon a photochemically sensitive layer of tissue called the retina. In loose descriptions of the eye it is assumed that the eye as a whole is the receptor, but it is worth while to distinguish between the end-organ proper and the accessory mechanical devices which add to the serviceability of the end-organ. The human eye appears to contain receptors of two kinds, viz., the rods and the cones, the former acting primarily under light intensities which prevail during the day and the latter acting under low intensities of illumination. The ear, to consider another illustration, is a clever mechanical device which collects air vibrations and conducts them to a sensitive structure called the basilar membrane. The basilar membrane, or small organs upon it, is thought to be the receptor for sound waves. End-organs located upon the tongue (little bud-like structures in the papillæ) and in the nostrils (the olfactory patch) are particularly sensitive to chemical energy in the form of molecular vibration. The skin is also sensitive in numerous isolated spots to molecular vibration (temperature changes), and it is sensitive as well to mechanical movements, for objects falling against the skin or striking it excite contact receptors buried in the skin tissue. Many of the internal linings and membranes, the muscles, the tendons, and the linings of the joints contain receptors which are excited by movements or pressures within the organism itself.

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[1] Herrick, C. J., *Introduction to Neurology*, 1916, p. 73.

The Effectors.—The effector system owes its origin to that native property of all living cells known as contractility. As a result of the process of differentiation of function the muscle cells lost a large part of their irritability and their capacity as conductors and specialized in the art of contraction. Like the receptor cells which specialized in the art of irritability, the contractile cells became attached to special structures which made their functions more variable and efficient than would otherwise have been the case. The muscle cells of a jellyfish, for example, are less effective than the muscles of a man, for the latter have at their disposal a bony framework which augments their range and delicacy of action.

The bones and muscles form a complicated system of mechanical advantages usually of the lever type. The operation of the levers in the human body are modified, however, by a nicely balanced antagonism of muscle groups, an antagonism which admits of almost any speed or any required delicacy of movement. In the arrangement of the muscles with respect to the bones one finds a maximal amount of mechanical advantage, a high measure of balance, and an amazing range of coöperation and organization not only between near-lying but remotely lying muscle groups.

There are two kinds of muscle fibers, the striped muscles and the unstriped. They differ from one another primarily in contraction time. The unstriped muscles, which are found principally in the digestive and circulatory systems, are much more sluggish both in responding to a stimulus and in returning to normal conditions after having been in a state of contraction.

The striped muscles, occurring principally in the organs of locomotion, contract more quickly and recover more quickly.

Muscles are capable of two kinds of movement. The first is called the simple twitch and is obtained when the muscle is excited by a single stimulus of almost any character. If this simple twitch is registered in an appropriate manner upon a revolving smoked drum (kymograph) the curve reveals two principal phases, viz., a period of contraction and a period of relaxation. The contraction results directly from a shortening of the muscle fibers and the relaxation brings the muscle back to its original length. Close observation reveals the fact that the muscle does not begin to contract at the precise moment of stimulation, but that there is a small latent period in which the muscle fibers prepare themselves for contraction. A simple twitch takes place in about one-tenth of a second. Of this interval, one-tenth relates to the latent period, about four-tenths to the contraction, and five-tenths to the period of relaxation.

The second form of contraction is known as the tetanic contraction, for it leads to a muscular state called tetanus or rigidity. Tetanus results when a muscle is being excited at frequent intervals, that is, when a second stimulus comes before the response to the first has been completed. The tetanic contraction yields a curve of greater height (greater intensity) and length (greater duration) than the simple twitch, and is, apparently, the sort of contraction most common to the organism. That is, the excitations from the cortex to the muscles come not in single impulses but in a series at about the rate of forty per second. This rate is well within the limits of what is known as the refractory period—a short period immediately following the contraction of a fiber during which it is not in a position to contract again.

There are a number of factors which vary the character of muscular contractions. Other things being equal, the muscles respond differently according to the strength of the stimulus, the duration of the stimulus, the amount and character of the load that must be moved or supported, the character of the muscle itself, the temperature, and the amount of fatigue product within the system. These facts will appear again when we consider the topic of human efficiency.

The Glands of Internal Secretion.—Accessory to the effector system and sometimes included with it are the glands of internal secretion or the endocrine glands. It is only within recent years that chemical and physiological sciences have discovered these glands and their functions, but so important and so far-reaching were the first facts that we already have an enormous amount of information about them. Among the glands which are of most significance to psychology are the adrenals, located just above the kidneys, the parathyroid, and the thyroid, located in the throat, the pituitary body in the brain, just over the roof of the mouth, the sex glands and particularly the interstitial cells, and the pancreas.

Adrenalin (the secretion from the adrenal glands) is increased in amount during various emotions (anger, rage, fear), and perhaps under fatigue, and brings about a marked rise in blood pressure, although heart action is retarded, an increase in the rate of oxidation in the blood, an increase in the amount of sugar in the blood, coming apparently from reserves in the liver, an increase in the rate of coagulation of the blood upon exposure to air. Death usually follows the removal of the adrenals. Before death the bodily temperature is lowered, extreme weakness sets in, the pulse becomes feeble, and the blood pressure low. We thus find in the adrenal glands a mechanism to support the view we have already advanced that emotion and mood reflect the tonic condition of the organism.

If the parathyroid glands are removed, an animal will die within a few days or weeks. Appetite is lost as a first symptom, and then the reflexes become highly excitable, issuing finally in cramp-like contortions and convulsions. Thyroid insufficiency can be remedied by an injection of the extract of parathyroid. If the thyroid glands are removed, bodily growth is arrested, the sexual organs are maldeveloped, and other symptoms of malfunction appear. The cretin, a person of low mentality, is an example of a creature suffering from thyroid deficiency. An excess of thyroid secretion, on the other hand, results in heightened nervous activity, irregular cardiac and respiratory functions, and pronounced changes in the metabolism. In other words, the thyroid glands appear to be somehow related to nervous stability and to the emotional life of an animal.

We have space for only a single fact about the sex glands. If at a suitable age the female sex glands are transplanted into a male from which the male glands have been removed, the creature with the new glands, at first designed to become a male, will develop all of the characteristics of the female, and conduct itself toward other males as if it were a female. Thus the bodily and behavior tendencies of the creature have followed the transplantation of the sex glands. This suggests that the secondary sex characteristics, both physiological and psychological, are a function of the interstitial secretions.

We now have enough evidence before us to make a generalization on the relation between the endocrine glands and certain aspects of intelligence. It appears that the prevailing moods of a person, his persistent gloominess, alertness, steadiness, nervousness, and many another personality trait, are functions of his glandular system. That is, the glands of internal secretion are effectors in the sense that they determine the tonus of the body, the prevailing energy or alertness level of the body. More than this, some of the glands, and particularly the thyroid, may exert a definite influence upon the tonus of the central nervous system, and thus upon the whole intellectual level of a man.

Verbal Response.—The vocal apparatus of all of the higher animals, and particularly of man, is one of the most remarkable instruments which nature has contrived for enabling organisms to make proper adjustments to their environments, and especially to what we shall call the "social environment," that is, the part of the environment made up of our fellow human beings. It is distinctive because of the following facts. (*a*) Because of the structure and situation of the vocal cords and by virtue of the related structures, human beings can make some thirty or forty different sounds. If we include differences in pitch (which are not often used as a distinguishing feature of vocal response) the number of sounds runs into the hundreds. The significance of these numbers lies in the fact that each sound and each combination of sounds may become an adequate stimulus, an essential part of the environment of almost all of the higher animals and especially of men. They have, by a process which is still to be described, become a primary mode of stimulus, a very essential part of the environment, of human beings. (*b*) The functions of the vocal cords may be exercised with a minimal use of energy. The amœba makes its responses by moving either a considerable portion of its body or by moving its whole frame. The amount of energy expended must be large in proportion to the energy available to so small a creature. In the higher animals and in man the expenditure of energy must be very small compared to the total amount available. A vocal response is thus an economical response, a saving way of settling accounts with the environment. (*c*) The vocal cords, and the whole vocal apparatus, because of its relative independence and its organic unity, can be used as a mechanism of response along with other mechanisms. There is thus provided a way of making responses which can be integrated readily with other modes of response, which may become an essential and integral part of other forms of response. (*d*) By virtue of the growing complexity of the nervous system and by virtue of the modes of operation of this system it has come about that the vocal mechanisms can be used vicariously for other modes of response. This process of substitution has, as a matter of fact, taken place in human beings, and thereby hangs the long story of the development of language. Language is an outcome of the substitution of vocal responses for other grosser responses. (*e*) The vocal cords are more or less hidden from view and the actual motion in them may sometimes be very small. For this reason, many of the verbal responses of the higher creatures and especially of man, remained hidden to casual inspection. This fact has given rise to the popular belief that men do not make responses to a great many of the stimulating objects in their environment, that instead they *simply see* or *simply think.* (*f*) The vocal responses are significant because they are distinguished as a trait of human beings. Great intelligence is also a distinctive trait of human beings, and it has, therefore, become common to assume that language responses and intelligence are most intimately related to one another. Animals do not speak, so we are told, (although some of them do have efficient vocal apparatuses) because they have nothing to say. However the relationship between language and intelligence should turn out, we cannot forget the fact that language seems to be chiefly a human achievement. Its relation to intelligence will concern us on another page.

Modes and Patterns of Response.—The physiology of the effectors, while telling us a great deal about the conditions which make for effective response, says nothing at all about modes and patterns of response, and these are of most interest to the psychologist. Of some of the simpler modes of response, such as the tropism, the reflex, and the complex modes of response such as the instinct, and habits and skills, we shall have more to say in the chapters on the intelligence of animals and on the growth of intelligence in the human child.

It is clear, of course, that the words instinct, habit, and skill say nothing at all about muscular patterns. What we wish to know is how muscles and muscle groups can be related to one another, of what behavior patterns or movement systems are composed, how part reactions can be molded into conduct.

A "movement system," according to Miss Washburn, "is a combination of movements so linked together that the stimulus furnished by the actual performance of certain movements is required to bring about other movements."[1] Movement systems are of two kinds, static and phasic. Static movement systems involve prolonged states of contraction and relaxation which are necessary for the maintenance of a posture or a stance. Phasic movement systems involve contractions which issue in some type of bodily translation in space. Phasic movement systems, in turn, may be either simultaneous or successive. In the simultaneous system we meet with a cluster of movements while in the successive system the contractions take place serially. Simultaneous systems are always cluster-like.

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[1] See Washburn, M. F., *Movement and Mental Imagery*, 1916.

We shall find, when we come to consider functional modes of operation of the nervous system (a discussion that ought not to be separated from a discussion of muscular patterns), that there is a multitude of ways in which movement systems may be united into patterns of greater and greater extent. Under the influence of determining tendencies and of associative tendencies, under the influence of instruction and of problems, simultaneous and successive movement systems may enter into combinations and complexes where the limit is set only by the limit of human achievement. What humans do in the way of verbal and manual responses, in the way of attitudes and postures, in the way of character or expressions of self,—these are the limits of combination of movement systems.

Movement systems may also be either implicit or explicit. An explicit system is, roughly speaking, a directly observable response, an overt reaction which admits more or less readily of objective measurement. An implicit response, on the contrary, is a response that does not lend itself readily to objective record.

This difference between explicit and implicit has assumed considerable significance in behavioristic theories and a quotation from Watson will illustrate not only this significance but the nature of an implicit response as well. "A man may sit motionless at his desk with pen in hand and paper before him. In popular parlance we may say he is idle or "thinking," but our *assumption* is that his muscles are really as active and possibly more active than if he were playing tennis. But what muscles? Those muscles which have been trained to act when he is in such a situation, his laryngeal, tongue, and speech muscles generally. (Indeed, the whole glandular and muscular systems are contributory.) Those muscles are as active and are carrying out as orderly a system of movements as if he were executing a sonata on the piano: they are doing it well or ill, depending upon the training he has had along the particular lines which engage him. While we cannot at present watch the play of this implicit stream of words, there is no reason for hypothecating a mystery about it." [1]

Implicit movement systems also create attitudes and postures. Whether one may understand that the motor pathways are more or less disposed toward discharge independently of implicit muscular contraction has not been demonstrated. But we do know that there are all degrees of readiness, and a multitude of attitudes which favor some reaction systems and some environmental situations rather than others.

The Great Central Adjustor.—Interpolated between the receptors and the effectors and connected with them by conduction fibers is a great central adjusting or integrating mechanism, an intricate device which permits the bringing together of stimulus patterns, their integration with the remnants of previous conditions of excitation and with the present general set or disposition of the whole system, and their re-creation into a suitable response pattern.

This great central adjustor, with all of its accessory structures, is composed of an inconceivable number of elements called neurons (their number is estimated at from twelve to fifteen billions). A neuron is a small nerve cell specialized in the art of conduction and composed of (*a*) a cell body with its nucleus and other internal structures (common to all cells), (*b*) an axon, a long slender fibril varying in length from a fraction of a millimeter to more than a meter, and (*c*) a dendrite or short, bushy, branching group of fibrils ending near the cell body.

The neurons in the brain appear to be so arranged with respect to one another (if not always structurally at least functionally) that the axon of one neuron terminates at or near the dendrites of another. Nerve currents are always taken up at the dendrite (the roots) and conducted through the cell out along the axon and discharged into the dendrites of the next neuron. Where the structural differences between dendrite and axon are obscure, functional differences, as measured by the direction of flow of the nerve current, still remain.

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[1] Watson, J. B., *Psychology from the Standpoint of the Behaviorist*, 1924, p. 15.

The points of connection or of association between neurons are called synapses. So far as we know at present, the dendrites and the axons of two functionally conjoined neurons do not actually grow together or perhaps even touch one another; at least there is a functional gap between them or a place of resistance over which neural currents cannot always pass as readily as they pass from one end of the neuron itself to another. The resistance which the synapse offers to the passage of a neural excitation has, as we shall see, a great significance for physiological psychology and for an understanding of many of the peculiarities of intelligent behavior.

When we regard the central adjustor as a whole there are certain specific structures which stand out prominently. Leading from the receptors to the spinal column are a very large number of nerve trunks which are called the peripheral or afferent or sensory nerves. These designations arise from the fact that they conduct to the spinal cord, and through the spinal cord to the central adjustor, states of excitation aroused in the receptors by the energies of stimulus. Running out from the central adjustor through the spinal cord and into the effectors are other nerve trunks called motor or efferent nerves, for they are known to carry impulses from the motor centers in the brain to the muscles, and through the autonomic or vegetative system to the glands of internal secretion, and to other effectors.

At the top of the spinal cord there are a number of structures of special interest. There is, first of all, an enlargement of the cord itself called the medulla oblongata into which come many of the cranial nerves and which probably serves as a center for the simpler cerebral reflexes such as the visceral, general cutaneous, and auditory systems. Behind the medulla and a little above is the cerebellum, an organ for the production of non-conscious motor coördinations and an organ for the maintenance of a certain level of motor tonicity, that is, motor balance. The cerebellum has special connections with the organs of balance in the ear (semicircular canals) and with the general musculature of the body. The two halves of the cerebellum are connected with one another by the pons Varolii, a bundle of fibers which crosses in front of the medulla. Still higher up on what is known as the brain stem (the projection of the spinal cord up to a point behind and slightly above the roof of the mouth) are a number of other special structures of which the thalamus and the corpora quadrigemina appear to be the most important. The thalamus is thought to represent a sort of vestibule or last relay station for all impulses, except those of the olfactory nerve, which are on their way to the cortex. It is also thought that the thalamus is the source of organization of impulses which manifest themselves in instinctive actions.

All of these structures and many other smaller centers which do not concern us in this book form a system which is called the old brain, that is, those parts of the central adjusting mechanisms which are very old and which have to do primarily with fundamental physiological reflexes and physiological types of organization. Surmounting the old brain and, in man, completely overgrowing it, is the new brain, the cortex, and the probable seat of those types of neural integration which contribute to the higher types of intelligent behavior. The new brain, or the cerebrum, is made up of an outer rind (cell bodies whose axons and dendrites run inward) called the cortex or the gray matter, and the inner layers called the white matter. It has been estimated that the cortex contains approximately three-fourths of the total number of neurons in the system, *i.e.*, over nine billion.

The Cerebral Cortex.—The cerebral cortex is probably the most marvelous instrument that Nature has ever invented. It will be a great many years before the half of its wonder is told, but even now the neurologist can hazard certain guesses as to its structure and functions.[1]

The cortex is superposed upon the lower brain centers, and it is not involved in activity except through these lower centers. The simpler reflexes probably run their courses independently of the cortex proper (that is, within the medulla oblongata, midbrain, thalamus, corpus striatum, etc.); but where the lower centers need integrating and combining, or where delays occur between the stimulus and the response, or where different centers within the cortex itself need integrating, one must look to the cortex for the necessary traffic lanes and for the necessary directing agencies.

It is thought that the primitive cortex was not involved in the production of neural activity; but after activity was once under way it served to amplify, recombine, redirect, or otherwise alter the neural patterns in relation to the stimulus pattern and to just completed and incipient behavior patterns. As Herrick says: "The cerebral cortex ordinarily is not activated by simple uncomplicated nervous impulses coming in directly from the periphery: but it is called into play by activities going on in the lower correlation centers and it articulates with these as going concerns. . . . The cortex is not reached by these nervous impulses if the situation is one for which the organization of the lower centers is adequate, that is, if a standardized reaction of reflex or instinctive type gives a satisfying result. Otherwise, collateral efferent pathways from the lower centers to the cortex are activated and the cortex participates in the reaction."[2]

Another function of the cortex is suggested in the following quotation, again from Herrick: "These mnemonic (memorial) functions of the human cerebral cortex are perhaps its most distinctive properties, upon which depend all the nobler human faculties. In situations where the immediate responses of the innate reflex and instinctive apparatus of the brain stem prove inadequate to determine the appropriate response, or where these simpler systems interfere so as to inhibit all reaction, there is stasis and summation in the lower centers, the longer cortical arcs are activated, mnemonic traces of previous allied reactions here laid down are quickened, and the dilemma is resolved in the light of the former experience.

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[1] Read Herrick, C. J., *Brains of Rats and Man*, 1926.

[2] Herrick, *op. cit.*, p. 260.

"It is not to be assumed that the memories to which reference is here made are psychological images, mythical subconscious entities, or so-called unconscious mind. Just what the mechanism is we do not know, but the assumption that best fits the observed facts is that every cortical association pattern when once activated leaves the synaptic thresholds (or whatever may be the apparatus of facilitation of path by use) in a different structural arrangement or 'set' which makes the reactivation of these neurons in this particular pattern easier than it was before. The thing which is preserved is static, a changed structural arrangement of parts."[1]

We do not have space in this book to describe in greater detail this great modern invention of nature, but we are tremendously concerned about its marvelous functions. It stands, as has been shown, between receptors and effectors and upon it devolves the task of integrating, organizing, selecting, and rejecting the excitations poured into it. What we must know are some of the principles which govern this endless process of selection and rejection, integration and patterning.

The Functional Unit of the Nervous System.—We begin with a brief account of what appears to be the functional unit of this great dynamic system. The structural unit of the nervous system is, as we have seen, the neuron just as the structural unit of the body as a whole is the cell (the neuron being only a specialized type of cell). The functional unit, the smallest theoretical working unit, is the reflex arc. A typical or schematic reflex arc consists of the following parts. There is, first of all, an afferent neuron whose dendritic processes lie in a receptor and whose axon runs inward toward the spinal cord.

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[1] *Op. cit.*, p. 264.

Here the excitation is taken up by the dendrites of a second neuron whose axon, in turn, carries the excitation away from the spinal cord and into an effector. A third neuron, called the intercalary neuron because it lies between the afferent and the efferent neurons, or any number of such neurons, connects the afferent part of the arc with the efferent part, either in the spinal cord itself (in the case of simple spinal reflexes) or at some one of the many levels which lie higher up.

Such a circuit of three functional parts, the afferent functions, the efferent functions, and the intercalary functions, gives us a clue to the general pattern of nervous functioning. The afferent and the efferent phases of the reflex arc do not appear unreasonably complicated, but the intercalary phase, the phase which lies in the great central adjustor itself, is too complicated to admit of suitable description. We know that the possibility for complication in the higher centers and particularly in the cortex is so great that an excitation from any receptor anywhere upon the body may conceivably find an outlet in an effector anywhere in the body. The modes of operation of the nervous system appear to grow out of and to be quantitative and qualitative complications of this functional unit.

Modes of Operation of the Nervous System.—The facts which we have just been reviewing are accessory to a matter which is of far more importance to the psychologist, *i.e.*, the ways in which the nervous system works, the facilities which it has for enabling organisms to make the functional relation which obtains between them and their environment an intelligent relation.[1]

Before we enumerate typical modes of operation it will be well to warn the reader that he must prepare to allow vague suggestions to carry the burden of the discussion. It is comparatively easy for the microscope to make dead neurons accessible to us; but dead neurons are not complex, living unities and neither are they incredibly elaborate organizations of neuronal patterns. From the study of simple reflexes, from the behavior of simple animals, and from reports about the sequence and interrelations of behavior patterns, on the one side, and mental events, on the other, we may draw inferences such as are suggested below; but it must always be remembered that the study of nervous morphology is advanced far ahead of neural function.

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[1] Read Sherrington, C. S., *The Integrative Action of the Nervous System*, 1906.

The reader must also remember that we are not attempting a critical survey or final list of the main types of neural function. All that we mean to do is to get on friendly terms with a certain kind of vocabulary and to have at least a speaking acquaintance with a group of ideas which may be of tremendous importance to the psychology of tomorrow.

The Law of Association.—Whenever any two neuronal systems are set into function at the same time they may tend to establish such relations with one another that a renewed excitation of either will, on a subsequent occasion, be adequate to the recreation of the original excitation in its companion. This is simply a statement of the primary law of association in neural terms.

The law has many corollaries. Let us assume that a neuronal system or behavior pattern has been created under the influence of stimulating and other contributing factors. This pattern will, then, tend to complete itself in the old way once the initial impulse has been given. For example, we pick up a few notes on the piano and shortly, without attentive regard, the whole piece has been played. A large part of our daily conversation is, no doubt, due to this principle. The total movement system, which is the piece of music as played, tends to repeat itself in a serial pattern which is more or less identical with the pattern originally determined by the printed notes on the score.

The Principle of Redintegration.—Somewhat the same facts can be expressed in still another way. After a reaction pattern has once been organized under the influence of a stimulus pattern, it may happen, on some subsequent occasion, that a single item only of the original stimulus pattern (not simply the first member), may be adequate to call forth the whole reaction pattern. This is particularly true of items of stimulus which come to have a high prepotency value for any particular reaction pattern. Other things being equal, the greater the number of items in the reconstructed situation, the greater will be the completeness of the old reaction system. This principle and many corollaries derived from it is known as the principle of redintegration. By one psychologist (Hollingworth) it has been raised to the level of a universal psychological law.

Both the law of association and the principle of redintegration lay emphasis upon what the gestalt psychologists call the "completion of the gestalt," that is, the tendency of all "members" to reallign themselves with the whole to which they belong. In other words, stress is being laid upon the *integrative* rather than the particularizing functions of the nervous system.

The Principle of Conditioning.—Whenever two neuronal systems are set into function at the same time they may tend to form such a connection with one another that the stimulus to the first will come to be tied to the response of the second while the left over stimulus and response drop out. Thus in Pawlow's experiments (p. 201) dogs learned to react to a bell by an increased flow of saliva after a bell and a piece of food had been offered at the same moment several times in succession.

The law of association and the principle of conditioning are two of the most suggestive principles that the psychology of learning possesses. The law of association means that environmental sequences or sequences furnished by the experimental setting (as in learning any task) can be transformed into neural sequences. It is also true that clusters of environmental factors can be transformed into clusters of neuronal organization. That is, we learn to make coördinated groups of simultaneous movements (or we enjoy associations of the topical kind) just as we learn a series of movements (or enjoy serial associations).

The principle of conditioning, on the other hand, makes it possible to tie old reaction patterns to an ever-changing stimulus. We shall attempt to show on p. 225 that this principle can be used nicely in the process of learning a language. When we recall that it is impossible for any living organism ever to make any *new* simple response to a stimulus we find new significance in the conditioned response mechanism. A dog may walk, trot, run, or jump, but conditioning makes it possible for any stimulus whatsoever to issue in one or the other of these movement systems. So it walks, trots, runs, or jumps at our command, at our whistle, at a passing automobile, at a stick thrown into the water, at a bird that falls under our marksmanship, and so on indefinitely through all of its accomplishments.

The Laws of Facilitation and Inhibition.—We have found that animal behavior is characterized by the prepotency of some situations and the impotency of others. In the history of psychology this fact is known as attention. We accounted for attention or prepotency in a general way by saying that the stimulus pattern commands attention because of properties intrinsic to it, and by saying that the original nature of the creature provides certain preferences or interests. Facilitation and inhibition run into the matter still more deeply.

Suppose that we have two pairs of antagonistic muscles, that is, muscles which would resist one another if both contracted at the same moment. There are such pairs in the legs. Now we may assume that the extensors of the right leg are under contraction, drawing the right leg forward. Simultaneously the flexors of the left leg are contracted, throwing the left leg backward. Now we may ask about the conditions of the other muscle groups, the extensors of the left leg and the flexors of the right. Are they merely idle? Experiment has shown that in simple reflexes like the scratch reflex of the dog the idle muscle is idle because the nerve fibers leading to it are inhibited. It has also been shown that the excitations leading to the contracting muscles have been facilitated.

If we apply this principle of facilitation and inhibition to the central nervous system we can easily see how it is that some neural patterns may become prepotent over others. Such patterns as are facilitated would become prepotent and, naturally enough, such as are inhibited would become impotent. This is the condition which obtains during attention when one object is reacted to at the expense of others. As a matter of fact, the principles of facilitation and inhibition have been used by more than one psychologist as the basis for a theory of attention.

The Principle of Synaptic Resistance.—The facts of inhibition and facilitation recall what has already been said about synaptic resistance. Every synapse seems to offer more or less resistance to the passage of a state of excitation across it. Consequently conduction is slower through gray matter than along nerve trunks. The amount of resistance at the synapses varies under conditions only a few of which we are acquainted with. We assume that it is lower along all innate reflex arcs. Thus we explain certain unlearned tendencies to action. And among these innate tendencies we may think of the resistance of some being lower than others for there are prepotent reflexes and prepotent tendencies of a more complex nature (instincts). As facilitation has shown, the resistance may be much greater at some synapses by having been lowered at others. Under conditions which we do not know at present the passage of a state of excitation across a synapse leaves the resistance at that synapse lower so that a second excitation will be more apt to follow the pathway of the first than to take any other pathway. Thus provision is made for learning.

But provision is also made for thinking or problem-solving. Problem-solving, the reorganization of old material into new and unique patterns cannot take place in a nervous system that admits of no delay between stimulus and response. Synaptic resistance thus offers us a way of seeing how neuronal systems may be established, how part systems may be shunted this way and that, and how unrelated systems may be brought into connection with one another, the final response being a reflection of the entire patterning.

Plasticity and Retentiveness.—No list of the talents of the nervous system would be complete without some mention of the most remarkable property of all living tissue, viz., the talent of being always and everywhere impressionable but always and everywhere a conserver of its previous condition. What this means physiologically or chemically we have only the faintest inklings. We are fairly sure that plasticity and retentiveness are not microscopically observable. An explanation of the facts is to be found rather in the molecular, perhaps even the atomic, structure of the nervous protoplasm. Such things as hydrogen-ion concentration and diminution at various parts of the neuron are known to be variable, and many attempts have been made to simulate the nerve processes in the laboratory; but knowledge is scanty. It will not do, however, to rest content with vague analogies about clay and putty and other impressionable substances. The facts are to be found, if they ever are found, in the physicochemical processes of oxidation during excitation and in the electrical phenomena set up by active nerve tissue.

Some writers have raised the fact of retention almost to the level of a general law of nerve function by pointing out that certain general organic states seem to favor the process of "stamping-in" a neural pattern while other organic states seem to hinder the process. We know also that other organic conditions (especially those obtaining during emotion) favor the break-up of old neural patterns and the establishment of new ones (as in conversion, see p. 325). There is, for example, a law of effect (Thorndike) which runs somewhat as follows: When a modifiable connection between a situation and a response is made and is accompanied or followed by a satisfying state of affairs, the strength of that connection is increased (synaptic resistance decreased). Conversely when the effect is annoying or unsatisfactory the strength of the connection is decreased (synaptic resistance increased).

The Principle of the Final Common Path.—Let us have under consideration a reflex arc. We are thinking particularly of the afferent or sensory segment. It is clear that the only excitation which can travel along this afferent path is the excitation which is aroused at its receptive point in the sense organ.

The efferent segment, however, is differently placed. Because of the facilities for change and interchange in the spinal cord and in all higher centers, any receptive point may throw its discharge into any given efferent arc. That is, an efferent segment of the reflex arc may become the final common path over which excitations from any receptive surface of the organism may pass.

We have space to mention only one of the many distinctive advantages which this arrangement affords. It enables the organism to use a limited number of behavior patterns in answer to an incredible number of modes and patterns of excitation.

Association and Dissociation.—The primary law of association, the law of conditioning, and other principles which underlie learning, make it possible for neuronal systems to combine into patterns of extraordinary complexity. This complexity may be topical, leading to that movement system or behavior pattern which we call an attitude, or it may be successive, leading to that movement system which we may call serial. Attitudes, or movement systems which become prepotent, that is, which persist for a season, "characterize" the organism and thus underlie that phase or aspect of a person we call selfhood. The same holds true of serial patterns. And finally, as Titchener has suggested, the nervous system must have general dispositions over and above any specific topical pattern or serial pattern and this leads also to selfhood.

But what is put together may also come apart. This is the pregnant fact of dissociation. Over and over in the pages which follow, and especially in the pages which treat of disorders of intellect and of behavior we shall have occasion to refer to dissociation. If the student will take the term in its present setting and hold tenaciously to it, he will find that many of the perplexities of hypnosis, suggestion, hysteria, double and multiple personality, dreams, mental healing, and many another psychological phenomenon will have lost its mystery.

The Physiological Chemistry of the Nervous System.—It is easy to talk glibly of nervous sets, neuronal patterns, synaptic resistances and the like, and a biologically minded psychologist might easily be accused of attempting to confuse the whole issue by using these terms rather than the standard vocabulary of psychology. The physiological chemist, however, is able to offer psychology a tremendous amount of aid and comfort. The problems are not by any means solved and some of the analogies are far-fetched, but one can at least begin to learn a new vocabulary.[1]

Nerve cells are physicochemical units. The processes that go on in them are like the processes that are studied in any chemical laboratory. The nervous impulse is probably of the order of electrical phenomena and involves all of the facts that concern electrons and protons, the formation and destruction of atoms, the building of molecules, and their subsequent disintegration. In synaptic resistance and in nervous conduction one must think of semipermeable membranes, hydrogen-ion concentration and the migration of ions, polarity and electromotive forces, the drainage of energy from some areas and the resultant recovery of the area, and a thousand and one other things that are common enough in the study of vital phenomena.

The inviting thing about appealing to the nervous system and its functions is that unlimited prospects for research are thereby opened up. There are some nine billion neurons in the human cortex and a knowledge of the "fields" that may be set up in this area and of the organization of patterns in these fields may transcend human technique, but there is no reason to be bashful. A heroic task attempted is better than idleness. The task is being attempted and the results already represent one of the most romantic moments of scientific research.

The Respectability of the Nervous System.—The chief argument against evolution was an emotional argument. Men feared for the dignity of Deity if it were shown that Deity was not a Creator, if it were shown that He elected to give men one of the most magnificent spectacles ever offered to human vision, viz., a spectacle of life, at first fleeting, fragile, untutored but persistent, trying and ever trying to stabilize itself, to insure itself a place in the economy of nature. In the same way we fear for the dignity of intelligence if it can be shown that nervous systems, at first simple, inadequate, but always persistent in the attempt to make the organic unity between the organism and the environment as rich and as manifold as possible, can account for all the facts that were accounted for by a soul.

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[1] Read Lillie, R. S., *Protoplasmic Action and Nervous Action*, 1923.

Our present appraisal of the nervous system is the housewife's appraisal who goes to the market for a morsel of food. What we need is a new respect for the nervous system and its capacities. It may be that not half the problems of psychology are to be answered in terms of it; it *may* be that mental powers or agencies step in to aid it at crucial or faltering moments; but one thing we must admit, viz., that problems of research in the structure and functions of the nervous system show no sign of coming to an end; and in a science, *that is the principal matter.*

The brain was once thought of as a machine for cooling off the hot spirits of the blood. It has been slow in rising from its lowly estate. Only a soul seemed great enough to act as a guest for intellect. We still regard the nervous system as an upstart, but psychology could not *lose anything* by taking the upstart for every bit of its worth.

PART TWO

GENETIC PSYCHOLOGY

CHAPTER V

THE APPROACH TO GENETIC PSYCHOLOGY

Introduction.—Genetic Psychology has to do with some of the questions raised by the following observations:

(*a*) Every human being begins his independent existence as a minute cell which is wholly devoid of those modes of behavior and of those talents or traits which we have all learned to call the intellectual treasures of the adult man. As time passes, this cell, or rather the creature which blossoms out of it, moves forward from a state of relative dependence and helplessness through a unique series of states whereby it becomes relatively more and more independent and more and more helpful. Immobility, awkwardness, stupidity, and automatic movements are gradually laid aside and increasing measures of dexterity, alertness, and general intellectual talent are taken on. Even at birth human beings stand lower than many of the animals in muscular and mental talent, but at maturity they are reputed to stand scarcely lower than the angels. What we observe, then, in the lives of our children is a steady accretion of intellectual talent. This process of growth or of change in capability is common to all living creatures, for every animal begins its independent existence with a few talents of "poor" quality and grows into or acquires many talents of "richer" quality. We leave out of account, for the moment, the questions as to whether any animal has by its growth or development actually improved or bettered itself. We wish here merely to signalize the fact that, from the point of view of psychology, life from birth to adulthood means a certain kind of change in capability, or in talent.

(*b*) When we regard the whole realm of animal creation we are quickly impressed with this fact, viz., that we can, if we so choose, arrange the whole assemblage with respect to capability so that, on the one hand, we find "limited" intellect and, on the other hand, after having passed along a fairly regular progression, we see "unlimited" intellect. Here, conjoined with great simplicity of bodily structure, we find inadequate skills and automatized actions, and there, conjoined with great complexity of bodily structure we find adequate skills and labile forms of action. The fact that an ascending scale of life, as measured by complexity, appears to parallel in a rough way an ascending scale of capability, we take only as an observed fact; its systematic importance will appear at a later time. We can, in other words, arrange our zoölogical gardens and our aquariums so that, in general, all living creatures will stand in a series with respect to their intellectual talents. This series may be made so real that even the lay visitor will gain the impression, as he passes from one species to the next, that those under immediate observation are better off intellectually than the ones he has just seen but not quite so talented as the ones he presently expects to see. What is more important, the unprejudiced observer knows that he himself belongs somehow to the series. That is, he recognizes some traits and capacities in the creatures before him which have risen to their zenith in himself.

For the sake of avoiding misunderstanding let us insert here a word about the phrase "better off intellectually." Intellectual talent among animals seems to imply two things, viz., (1) increasingly perfect adjustment to limited conditions or special environments, and (2) increasingly variable modes of adjustment—perhaps also increasingly perfect adjustment—to a variable environment. In either respect the observations made above hold true. The ant, as we shall see, appears to be better adjusted to its range of environment than the creatures below it in the scale of life, even though its perfection lies in a refinement of response to a fixed environment, to a world that must not change. A great many plants are also adjusted to a precise environment; nevertheless, we should all agree that their level of adjustment is lower than that of the ant. The usual criterion of living and of evolution is capacity for diversified living, an increasing range of natural responses to an increasing range of natural situations.

(*c*) Among those peoples whom we choose to call primitive or uncivilized we find stories, established modes of living and of thinking, and other modes of behavior which appear to reflect talents notably different from our own, talents which give the distinct impression of being less noble than our own. After we have burrowed into the villages of people who lived ten thousand years ago, or after we find the caves of a people who lived twenty-five thousand years ago, we gain the impression that these people were not so richly endowed as we are with what we may call intelligence. At a later time we must consider this observation with critical care; but for the present we may make use of a general impression, viz., that human beings have, during the last hundred or more thousand years, changed in talent or, as we may put it, increased in talent. This difference in talent is just the difference between what historians have called civilized and uncivilized peoples, the latter being said to be the more primitive. There is no dispute at all over the fact that civilized peoples have acquired an amount of knowledge greater than that known to primitive minds; that is, we are, by our own standards, at least, more civilized. We look beyond this fact, however, to the conjecture that the intellectual instruments used in creating art, literature, science, and philosophy are now more highly developed than formerly. Again we leave out of account the question as to whether we are better off than primitive people.

(*d*) When we review the history of life upon the earth as it is told in the rocks and in the products or monuments which living beings have unwittingly erected to their own memory, we discover still another sequence of talent, but this time the sequence is correlated not only with "ascending" complexity of structure but also with the passing of time (as the geologist would use the term) so that humble intellects appear to antedate regal intellects. The older the form of life, the simpler its bodily structure and the more meager the talents of the creature. Those species generated most recently—as biological and geological time goes—are not only more complex in bodily structure but are also more richly endowed with intellectual traits. One gains the impression, after having visited a good geological museum, that life and intellect, throughout all the ages, have been looking toward man. These two last observations, when put together, suggest the thought that the most recent creatures of geological history should somehow fit into the earliest of human history. In other words, we meet the inspiring thought that life from its very beginning to the present has been moving toward man.

(*e*) The life of the human child from infancy to maturity is a unit, a self-inclosed series of events. In the same sense, animals now living form a self-inclosed series, and so too the organisms which have left their imprint on the rocks. Each series appears to be too complete to be the result of chance or accidental factors. As a matter of fact, each series is so full of gaps and exceptions as to make their serial, forward-moving, consolidated character, appear a bit doubtful. On closer inspection, however, these gaps and apparent exceptions help to support rather than to destroy the arrangements we think we have discovered. (1) Idiots appear to be human beings for whom the processes of bodily growth have been fairly normal but in whom there has been no correlative increase in intellectual talent. Imbeciles and morons represent persons in whom the addition of intellect has been a laggardly process. Instead of standing as genuine exceptions to observed growth, these persons represent cases in which whatever principles or forces or patterns may come out of the study of child psychology have either failed or have been reversed. (2) Some persons climb the steps toward greater intellect and then for various reasons, during early adolescence, turn around and retrace their journey. We call this disease dementia præcox (see p. 379). A person may live well until old age and then relive his childhood as in senile dementia. Then there are all kinds of mental ailments which are characterized by genuine "flights" into childhood or even into alleged prehuman modes of experience. In these cases also we may say that the exceptions are somehow related to a pattern of forward-moving change. (3) Certain animal species are also thought to have climbed the ladder of life for a season, and then, wearied of the effort, either stopped or retraced a part of their pathway to end up as parasites in the bodies of more enterprising creatures. Parasitism, then, may be a movement of life counter to that described above, but supporting, nevertheless, the idea of organic development.

The Problem.—We have, now, intimations toward five groups of facts, viz., toward the facts of child psychology, the facts of comparative animal psychology, the facts of folk psychology or of anthropological psychology, the facts of paleontology, together with the psychological inferences to be drawn from them, and finally toward the facts of abnormal psychology and of parasitism. We have no sooner laid these facts before us, however, than we are confronted with a multitude of the most urgent questions. We leave out of account, for the moment, questions which would have to do with the experimental extension of each group. We shall take it for granted that these five fields of research mark a distinct part of contemporary psychology and, as we shall find later on, each field is already replete with more material than we can possibly crowd into a single book, to say nothing of a section of a book. The questions we ask now have to do, not with the experimental extension of the facts, but with their meanings when taken in conjunction with one another.

(*a*) We begin with the question: What is the meaning of the observation that the infant grows into manhood? Have we gleaned all of the fruits of our labor when we have written the diary of 100 or 1000 subjects from birth to adulthood? Modern education demands that we go beyond the diaries and search out the principles which determine the growth or development of the child mind. We ask not only about the stages through which human beings pass in their journey from incapability to capability but about the fundamental nature of the passage itself. Does the history of the child show that it passes from a less logical to a more logical, a less skillful to a more skillful, a less thoughtful to a more thoughtful individual? That is, do we have to do here with a mechanical sort of movement from infancy to adulthood, a purely physical movement, an arithmetical summation of capacities, or do we have to do with a dynamic process that begins at a qualitatively lower and different level than it ends, a process that is, in a sense, continuously creative, a process that gives in higher stages capacities and traits that are unique in comparison with those that precede? Or, conversely, if in imagination we reverse the process, is it of such a nature that we can merely subtract traits and capacities and have left the starting point? Do abnormal minds, dementias in particular, represent merely subtraction of mental capability, do parasites represent merely subtraction of biological traits and capacities, or do we have to do with a process of change that is unique in each of its stages?

(*b*) How are we to think of or interpret that unique series of capacities to be found among the animals, from the amœba to man? Should we take living beings as a sheer aggregate, a haphazard assemblage of creatures, thrown about like the toys in a child's playroom? Is there only a comparative animal psychology which we pursue out of natural curiosity, or are there principles which underlie and which may have determined the progression in talent from simple creatures to man? In other words, if one must order and arrange what one sees, if the zoölogical garden must be systematized, why select talent as a guiding principle? Why not select size or form or number of bones per creature or morphological characteristics, as was so often the case before Darwin? In other words, why is the arrangement with respect to talent of any more value or interest than the observation that one child arranges his blocks from small to large, another with respect to color, and still a third from round to square?

(*c*) How are we to think of the changes from Cro-Magnon man to present-day man? The former lived in a cave and fashioned his implements of stone and bone and lived scarcely higher than the animals. How shall we understand the processes that have led this creature and no other creature to abandon a cave in favor of a house, to abandon stone in favor of gun and powder, to abandon crude magical belief in favor of science and invention? Has this cultural advance resulted from a mere accumulation of facts or is it a reflection of changing capacities?

(*d*) Similarly, how shall we view the procession of talent which we find embedded in the rocks? Do we have to do here with a comparative paleontology whose sole problem is the pointing out of similarities and dissimilarities as one would compare the houses along a street? Or do we have to do with a series of differences in talent which reflect fundamental principles and laws? We must inquire also as to the relation between this series which ends somewhere short of man, and the previous series which begins somewhere higher than the animals. There is already plenty of evidence which suggests that this gap can be filled. May we expect the gap to be wholly filled and may we hope to find that whatever principles account for the succession of talent up to the higher animals are actually effective in prehistoric, in primitive, and in modern man?

(*e*) Can we think of the failure of infants to develop in a normal way or of the retrogression of children and of adults and animals after normal development as in any way related to the breakdown of the laws and principles of development, should any such be discovered? That is, if in our consideration of child psychology, of comparative animal psychology, of folk psychology, and so on, we should find any principles that enable us to think more clearly about these fields and explain the conjectured relationship between different forms of life, either with respect to single fields or with respect to all, can we go ahead to believe that a failure in these laws will lead to retrogression after development or to uncompleted development or finally to idiocy or to parasitism?

(*f*) If we find, as an answer to our first group of questions, that the passage from infancy to childhood is a process of growth or evolution subject to certain well-defined laws and principles, can we apply these laws and principles to the understanding of the animal kingdom both with respect to its present state and with respect to its history as revealed in the rocks? Conversely, do the principles that account for the variable talents of animals throw any light upon the increasing talent of infants? Similarly, we may ask if the principles derived from the development of human infants throw any light on the mentality of primitive peoples; and conversely, Do the principles of primitive mentality throw any light upon the development of the human infant? It was at this point that the modes of thinking which came out of the doctrine of biological evolution first entered psychology and, as we shall see, there are a great many facts of so-called folk psychology which are often put into relation with the facts of child psychology.

The Genetic vs. the Static Points of View.—Answers to these questions depend upon what we shall do with two modes of thinking that are as divergent as east and west. Both ways of thinking are as old as philosophy, but the one, the creation way, has been, for a number of centuries, the most popular way. The other, the genetic way, has until recently found favor only among certain philosophers and men of science. Today it has become a predominating mode of thought in all of men's councils. The long life of the creation way is due in large part to the support which it has had from theology and from other forms of religious dogma; but it has found favor also because of its great simplicity before minds that are not in the habit of inquiring too deeply about nature.

According to the creation way all was void until by the voice of a Creator or by the power of some impersonal creative agency or because of the mere fulfillment of time, everything that now *Is* was suddenly brought into *Being*. Time has passed since that eventful beginning, but distinctive changes have been relatively few since a stamp of divine approval was set upon what had been made. The world was created and the interrelatedness of its parts in all essential matters was established for eternity. Of qualitative changes since then, there have been none. This means that morals, political institutions, social relations, languages, life in its many species, intellect, to say nothing of the inorganic realms of being, were ready-made at the hands of the creative agency or are the direct and invariable result of laws and principles that were then established, never to be changed until time shall be no more, or the Creator shall decree.

It now becomes plain that the questions we have raised above are, for the most part, meaningless to an adherent of the creation way or static way of explaining life. The static view of the child finds the soul, *i.e.*, The Mind of the child, a natural gift with predetermined dimensions and talents. Since the adult professes to know himself and is able to recognize in himself certain faculties and capacities which belong to him by right of creation, these same capacities and traits are accepted as belonging to the intellectual equipment of the infant. The intellect of the child is thus said to be a small edition of the mind of the adult. It is as if we viewed his intellect from a distance and found it like the adult intellect but reduced in size. The observation we made a moment ago about the change in capacity or talent from infancy to adulthood is said to be an illusion. It is said that, as a matter of fact, all the traits of the parent are present waiting only to mature and to develop, that we may understand the adult as enjoying quantitative increase in the magnitude of childhood traits and capacities; and likewise we may understand the infant by a subtraction of or a mechanical deflation of adult capacities. The folly of this view will appear in a few moments.

To the believer in creationism there is, likewise, no problem at all in the fact that the members of the present animal kingdom vary in intellect all the way from the fixed tropisms of the amœba to the inventive genius of the ape. Each animal after its kind was made as it is. What is simpler! Having once been made each has continued to produce its kind.

The geological record is a little more perplexing. The facts are usually explained away by some such argument as (*a*) the geologist has misread the record, or (*b*) Deity created species at successive intervals, caused them to prosper or die out, and added new species as He saw fit.

The holder of the creation view finds great comfort in the assertions of modern research that man has, in his intellectual talents, undergone no material change in the last ten or twenty thousand years. Three comments are in order with respect to this fact. (*a*) Ten thousand years is not a significant interval in the history of life. (*b*) Experimental methods are not yet adequate to the study of modern and primitive *native* talent. (*c*) No one knows at the present time anything about the relation of knowledge gaining power to the amount of knowledge gained. Primitive man may or may not have had the same power as we do. The difference in store of knowledge may or may not be an asset to an intellect.

Finally, the facts of abnormal psychology fail to raise an issue to the believer in creationism. Demon possession and philosophical speculations about the problem of evil throw little light upon modern methods of diagnosing and treating intellectual failure.

The creation mode of thinking has had a curious effect upon science, history, philosophy, and religion. Under this quasi-stationary point of view, for example, science could hardly be more than a descriptive discipline wherein the objects that are given by creative power are to be classified and critically reviewed much as one might compare and classify the cars at a midwinter automobile show. So we have or have had mere compendia of the stars, of geological formations, of plants and animals, that are nothing more than card catalogues of the objects about us. Analysis and classification,—that was said to be science.

As we have suggested, the static view of nature prevailed for a great many centuries; but in learned circles the cardinal ideas of organic evolution have demanded an equal measure of attention. Evolution was a part of the philosophy of some of the early Greek philosophers, and notably of Aristotle, who incorporated the idea into his whole plan of thinking. The doctrine took new form and interest at the hands of the 17th and 18th century philosophers, and in the last century it became a dominating scientific generalization. First in astronomy and then in geology the doctrine came to have convincing words to say about the origin of the natural world and about its subsequent history. Finally, shortly after the middle of the last century, Darwin extended the principle to biology and made it "current intellectual coin." Today evolution is a part of our common culture.

This change in opinion and thinking has been of a magnitude comparable to that which took place in physics and astronomy at the time of Copernicus. The new intellectual atmosphere is now so common that the younger students of today can scarcely realize how different their own mode of thinking is from that of their grandfathers. Yesterday men spoke of a created quasi-stationary world which had its boundaries fixed, its relations established, and its mental and moral values relatively unchanged and unchanging. Today we speak of the genesis and the evolution of objects, of origins, of growth, of survival, of biological values instead of eternal values.

An Example of the Genetic Method.—Examples of the beneficent use of the principle of genetic continuity appear in almost every science; but we shall choose a single case from the history of geology.[1] Petrography is that branch of geology which has to do with the description of rocks. Now a large part of the early history of petrography or mineralogy consists of discussions like Woodward's (1695) on the relation of coal, gravel, and granite to the Flood, or of attempts to describe rocks according to hardness, specific gravity, geographical location, mineral composition, and the like. By 1870 the possibilities of increase of knowledge through the descriptive study of rocks seems to have been exhausted. All the known rocks had been properly placed in schemes of classification and there was nothing left by way of description to be done. The finer structure of the rocks could not be seen and a natural death threatened the science of petrography. But during the last quarter of the 19th century a temporary rejuvenation came in the discovery of a way of applying to minerals the compound polarizing microscope. Taken by itself this discovery merely prepared the way for a quantitative and not a qualitative advance. It increased skill in description, but it could not materially change the character of petrography. One startling fact, however, was discovered, viz., that the chalks and marls are made up of the skeletons of dead organisms. Even this discovery would not have been so significant had it not been for the great influence which evolutionary doctrines were exerting at the time. As matters stood, the discovery led directly to the assumption that rocks, like life, have had a history. This assumption was not, of course, entirely new. In 1740, Moro had sought to explain fossils by contending that rocks must have been in the process of formation when the fossils were included. Lyell's epoch-making *Principles of Geology*, published in 1830, also assumed a rock history and probably played no small part in directing Darwin toward his theory of natural selection. At any rate, it happened that, toward the close of the last century, petrography became petrology; a science of description became a science of the genesis and growth and historical meaning of rocks. Here was a qualitative advance in this branch of the science of geology. A task of classification which had threatened to become highly artificial changed overnight into the study of an on-going process. Rocks were seen to have temporal and not merely cross-sectional relations. Werner had insisted earlier that chemical composition was the most fundamental characteristic of rocks, and yet it had become distressingly obvious to mineralogists that the most precise determination of the chemical structure of all the rocks in existence would not of itself explain the origin of rocks or contribute more than unrelated facts to the history of the earth. Modern geology, then, finds description only the starting point for an absorbing study of the genesis and gradual transformation of rocks. Under the new science, the work of physiographic forces and the analytical and genetic description of the stages through which rocks and minerals pass from undifferentiated masses of molten or liquid material to their final form as quartz, sandstone, and marble is a matter of laboratory reproduction. Every branch of science has been moved by evolutionary doctrines in this same manner. Description is not enough. Genetic continuity must make meaningful that which analysis has given. Under mere description or under the static view fossils may be God's imperfect or incomplete trials, they may have been set in the rocks to test man's faith, they may be the result of a fossil-making force, they may be sports of nature, or due to spontaneous generation, or they may have come from animals drowned during the Flood. Under the genetic method, however, they fall into a series; they make a history; they are readily put into order or into sequence; they mean something intelligible to science.

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[1] Gregory, H. E., "History of Geology," *Sci. Mo.*, 1921, Vol. 12, pp. 97–126.

Definition of Evolution.—We can no longer postpone a definition of the word evolution. Even in biology we meet with ambiguity. Of the dozen or more meanings that are in common use we select three in order to illustrate the problem of definition.

In the first place, one may mean by evolution a mere chronological diary, a running account from age to age of successive animal forms. This sort of record would give us changes in body and in intellect as time goes on without regard to the way in which the changes may be related or without hinting at the fact that these changes may be interdependent and causally connected. In this sense we might speak of the evolution of intellect much as we would describe the houses along a street, or number the pickets in a fence. This was the plan which was followed by the older systems of comparative anatomy, comparative philology, and comparative psychology. The geologist often describes strata in this way. This might be called, therefore, the geological definition of evolution.

In the second place, we may come closer to the etymological meaning of the word itself, and relate the discrete facts listed in the older comparative sciences by some principle of ligation. We may, for example, view them as phases or moments of a movement or a pattern. In this way continuity is established in the series and successive terms of the integrated whole bear a definite relation to preceding and succeeding terms. Finally, evolution may be regarded as a process of perpetual creation, as an account of the development of unique structures and functions because of some original creative force or in line with some biological urge. The phrases "emergent evolution" and "creative evolution" have become popular in recent philosophy.

The first definition of evolution is open to criticism, since a day to day account or a diary does not lead to an understanding of a process. A bare chronology or diary does not lead to research; it calls only for a ledger. A chronology of life has no temporal significance. The third interpretation implies problems lying too close to philosophy. It makes assumptions which are not necessary to an understanding of the facts. Intellect *may* be developing toward some goal, it *may* be a process of emergence, it *may* point to some sort of creative energy or agency; but no more can be said upon an empirical level; no one of these assumptions can be treated in a laboratory.

We have left the second definition which predicates of evolution a process where the records we make or the items we list are phases of the process. This process, moreover, can be described by one or more unifying principles. The principle commonly used in psychology (this principle has been borrowed from biology) is the principle of complexity. As life passes on from moment to moment, there is an accretion in the number of intellectual talents, an increased capacity to profit by past experience, and a widening of the range and refinement of other mind-body performances. It is said that, "as we follow the development of animals in time, we find the capacity to select impulses growing" and that "this growth in the number, speed of formation, permanence, delicacy, and complexity of associations possible for an animal reaches its acme in the case of man." [1] Others, as we shall find, assume that mental life increases in complexity *pari passu* with an increase in the complexity of neuronal systems. Still others regard mental evolution as an increase in the number of mental processes which results in an increase in those organizations and patterns of which the stream of mental life is constituted.

The Problem of Genetic Psychology.—We have indicated in a general way, the problems of genetic psychology, but now we must speak even more definitely and exactly. We have before us the fact that the intellectual talents of all creatures have changed during the course of time. We have also before us a theory, a generalization, which attempts to explain the meaning of apparent growth in intelligence. Genetic psychology becomes, then, that branch of the whole science which seeks to discover facts about intellectual development and to derive general principles from these facts. Wherever intellects appear, there genetic psychology asks a question.

But the problem is even more detailed and specific. We have described seven moments of intelligence, seven phases of that unique relationship which living creatures sustain with their environment. Degrees of animal intelligence may be got by listing the effective environment of any given creature, by determining the extent to which (and the conditions under which) parts of this environment become momentarily or more or less permanently prepotent over other parts, by remarking the extent to which responses suffer change and improvement under practice, by noting the facility with which different creatures alter the energy of their responses, that is, adapt their energies to the needs of the occasion, by noting the extent to which life may divine and prepare for the future, by measuring the extent to which organisms may insert productive delays between stimulus and response and, finally, by noting the extent to which responses can be organized into distinctive and useful patterns (character traits). Genetic psychology may particularize its task, therefore, and describe the development of each one of these moments of intelligence. In the child, in the animal series, in the history of life, so far as it is available to us, we may attempt to trace those changes and events which have brought genius out of intellectual lowliness.

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[1] Thorndike, E. L., *Animal Intelligence*, 1911, p. 285.

There is, however, still another problem, a problem which is revealed by the question: Must we write several genetic psychologies, a genetic psychology of the child, a genetic psychology of animals, a genetic psychology of primitive people, or are there general principles of intellectual development which can be derived from these separate fields of inquiry?

The Theory of Recapitulation.—There is a theory which states that the intellectual development of the child is a pattern of phylogenetic (racial) development. This theory affirms that an individual runs through during his life and in a brief or summary fashion the whole experience of the race much as each new installment of a novel begins with a résumé of preceding chapters. The recapitulationists argue from the apparent similarity between the growth or development of the human embryo and the embryos of other animals. They point out the resemblances between the human embryo at various stages in its development and the embryos of many other animals standing lower in the scale of complexity, but presumably in the line of descent of the human body. There is a time when the embryos of some of the vertebrates cannot, under ordinary inspection at least, be distinguished from one another. All of them seem to be running true to the same pattern.

The recapitulationists argue also from the many vestigial organs which belong to higher species. In the human body there is said to be a reduced third eyelid (as in birds and amphibia) and vestigial ear muscles. Structures more commonly known are the gill slits, the appendix, the heart in its early forms, and retrogressive sense organs. From this background they turn to the mental life of the child and of the adolescent and allege the discovery of all sorts of experiences that are said to hark back to the presumable experiences of the race. They find that experiences which are supposed to have occurred when living forms were just leaving the water and taking to the land are apt to reappear in fragmentary form in the life of a child or an adolescent. There are said to be sex perversions replete with intimations of the past history of the race, phobias, fugues, imperative ideas, atavistic swimming and paddling movements, a nascent sense of death, and a host of other things which show that "the child is vastly more ancient than the man."

It is apparent, from such a doctrine as this, that if the life of the young child and of the adolescent were well known and if it could be established that body and intellect do repeat epochs from the total history of life, psychologists would have an interesting task in unraveling the intellectual history of the race from the tangles that are alleged to remain.

The theory of recapitulation has appeared a trifle extravagant to some students and they have urged, therefore, a little more moderation by demanding that researches be instituted which shall reveal as many correspondences as possible between ontogenetic and phylogenetic development. It is obvious, of course, that ontogenesis and phylogenesis are closely related processes, for each has to do with the development of organisms. It would not be at all improbable, therefore, that certain characteristics of development, special crucial factors, should play a dominating part in both series of events.

These thoughts receive greater significance in view of the fact that evolution is a word that applies to the whole of nature, organic and inorganic alike. A universal principle of evolution which comprehends general principles is an attractive thought. If the universe is a natural universe, if it is, at heart, a homogenous structure, if its processes are all of a pattern, we might expect parallels in development rather than wide differences.

Comparative Psychology and Genetic Psychology.—We have chosen to think of animal psychology, child psychology, and folk psychology in terms of evolution, that is, in terms of genetic psychology. We have done this in order that we may consider two groups of problems at the same time, viz., (*a*) the facts of animal psychology *as such* or the facts of child psychology *as such*, and (*b*) in order that we could illustrate the general problems of genetic psychology. The reader will realize, of course, that the facts of animal psychology easily form an independent body of knowledge as do also the facts of child psychology. Where they do not, it is still possible to think of them as belonging to comparative psychology, that is, to the study of likenesses and differences in the intellectual talent of different creatures.

It must be remarked, however, that in the history of animal psychology, comparative studies have had a certain pragmatic value. By comparing the structure, the nervous system, the sense organs, and the behavior of animals, and by comparing experimental data it was possible to make certain guesses about the mental life of the lower animals. This was, while it lasted, an interesting game but it often betrayed the cleverness of the comparer rather than the intellectual rating of the animal being studied.

Summary.—We may now, in the light of the doctrine of evolution, venture certain answers to the questions we have raised as belonging to the domain of genetic psychology. Conditional upon subsequent demonstration and proof we may say (*a*) that the passage of human life from a single cell through adulthood to old age is a genuine evolution, marked by the serial appearance of new capacities and traits and that it is not to be conceived merely as a process of enlarging traits and capacities already present which are either small or dormant; (*b*) that the array of talent which is projected directly or indirectly in the geological history of the earth is an array which derives its significance from the fact that intellect, like life, has had a history, and that this history parallels in a rough way the main events in the development of the talents of a child; (*c*) that the arrangement of animals in the zoölogical garden according to talent is a significant arrangement, in that the whole scale of life as we see it about us today is a vivid picture of the intellectual differences through which life has passed in ascending to its present level; (*d*) that there are principles of mental evolution that belong to a generalized doctrine of evolution and which, so far as they touch intelligence, find themselves exemplified in the growth of the child, in the history of the race, and in the differences in talent among the survivors of the long process of evolution; (*e*) that the abnormalities or hesitations in development which we find among living creatures and the fact of parasitism may be taken as failures of developmental principles, lapses and exceptions to what otherwise may be called forward-tending influences in a natural universe.

CHAPTER VI

THE DEVELOPMENT OF ANIMAL INTELLIGENCE

Introduction.—Intelligence is as old as life. The very first living creatures had to demonstrate their talents for getting on in an environment even though their period of life may have measured but a few seconds. The first colloidal complex that was able to sustain itself for a few moments as an independent compound, deriving energy from its environment, storing some of this energy at a high potential level within its own structure, and expending some of it to get more or to move into a position to get more, had an effective environment and got on in a very simple way in this environment. There were no special instruments for aiding and promoting the behavior of this creature, none save such orginal properties as sensitivity, conductivity, and contractility. There were no eyes or ears, no interconnecting nerve fibers, no higher correlation centers such as were described at the end of Chapter IV. Surely a humble beginning, but no more humble than life itself, and withal, a beginning!

The problem of the genetic psychologist in the field of animal psychology is to trace from the humblest beginnings which he can find those stages and changes of intellect which cause us to think of animals as lower or higher in talent. To take intelligence in the large, however, would confuse the problem, for intelligence is a final judgment we make about a creature and not something we should posit of him at the start. What we observe in animals is their success or failure in getting on in an environment and, as we have seen, this success or failure can be described in several different ways. We shall suggest, therefore, some of the problems that arise when we ask about the origin and development of the diverse capacities and talents of life.

THE EVOLUTION OF THE NERVOUS SYSTEM

A study of the evolution of the nervous system includes a study of the development of the receptors as well. The simplest organisms of which we have any account are made up of living stuff which has the following properties, viz., sensitivity to stimulating agents, conductivity of excitations from one part of the substance to another, and contractility. The property of being sensitive to stimuli is the fundamental physiological fact underlying the origin and the development of specialized receptors. The amœba, to take a creature very low in the scale of life, has no special sense organs, the whole protoplasmic substance being sensitive to changes in light. But only a few steps higher in the scale one finds creatures with a small pigmented spot which is sensitive to light in such a way that the creature can respond not only to changes in the illumination but orient itself with respect to the direction of illumination as well. This pigmented spot appears to be the precursor of the eye. The detailed history of the changes that have taken place in this pigmented spot is a long story that falls outside of our present interest, but the entire account gives us a picture of the manufacture of an instrument that became increasingly effective in putting the organism into relation with many different properties and qualities of light stimuli. The developmental story of how we came to have eyes is repeated in the story of how we came to have ears, chemical receptors in the nose and mouth, and receptors of various types in the skin and in the internal organs. These various stories unite with one another in giving us the conviction that life has, through the receptors, become increasingly able to relate itself to the energies that flow about us.[1]

The "Physiological Gradient."—The physiological property of conduction appears to underlie the origin and development of the nervous system. An amœba is untalented, according to our human standards of talent, in part because it has no specialized receptors and in part because it has no specialized conductors that will carry a state of excitation from the stimulated area to a specialized organ of response. The responses of the amœba to its environment are always, therefore, immediate and unspecialized responses. The studies of Child, Herrick, and others show, however, that in these simple creatures there is already a suggestion of some dominance of one part of the creature over another. There are regions of higher excitability or of increased metabolism and these regions are believed to exert a regulatory influence over other portions. There is thus a physiological state which Child has called the "physiological gradient." These gradients make it appear that even in the simplest of creatures, there is a "head end".

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[1] Read Parker, G. H., *The Elementary Nervous System*, 1914; Child, C. M., *The Origin and Development of the Nervous System*, 1921.

The Effector System.—Within this physiological gradient and among creatures which are beginning to show some differentiation of structure one finds cells in which the functions of receptivity, conductivity (so far as conductivity is required), and contraction are magnified. In sponges, for example, there are simple effectors upon which stimulating agents impinge and which respond either by closing the pores of the sponge to obnoxious substances or opening them to nourishing substances. Parker has called these simple effectors the primitive nervous system. It is obvious that a creature equipped with such a system can act only under direct stimulation of the environment, that its range of sensitivity is limited, and that its responses are very sluggish.

The Receptor-Effector System.—A further stage of development may be seen in the receptor-effector system of the sea-anemone or the jellyfish. In this type of nervous system a cell is set aside as a receptor and under development it becomes especially sensitive to a limited range of stimulating agents, viz., to pressure, chemicals, and light. The excitation aroused in the protoplasm of the receptor is discharged through simple paths of conduction to a near-lying, usually an adjacent, muscle cell or effector. Gradually the paths of conduction are lengthened, that is, the distance between the receptor and the effector is increased. Moreover, an arrangement appears which insures the conduction of the neural excitation to a great many cells instead of to a single cell. It is this latter sort of complication which appears so clearly in the jellyfish. The fibers joining receptors and effectors have grown into a fairly elaborate network and such a nervous system is called, therefore, the nerve net form of receptor-effector system. Frequently, the receptor-effector system is complicated by the addition of intercalary or connecting nerve cells which admit of the effector being distantly removed from the receptor. A deep-lying muscle cell may, then, be activated through the intermediate cell by a receptor at the surface. The receptor-effector system is obviously a distinct improvement over the simple effector system. The range of sensitivity of the receptor is increased and muscular responses are capable of useful gradations in intensity. There is, however, no single nervous organ to which any possible mental experience may relate. The transmission of impulses through the system is diffuse, a nervous impulse spreading out like a wave over the transmitting tissues.

The Great Central Adjustor.—A third stage in the development of nervous systems is characterized by the appearance of a definite central adjustor. In the earthworm the central or intercalary neurons appear to have collected in ganglia, one for each segment. These ganglia begin to exercise a certain facilitating or inhibiting effect upon the network of each segment and sometimes upon neighboring segments. Such a system is called a receptor-adjustor-effector system. As the adjustor increases in size and in importance it migrates to the head-end of the organism, perhaps, as Child and Herrick suggest, under the influence of the physiological gradient. There other changes take place. Within itself differentiation occurs. Groups of cells are gradually set aside for definite types of bodily function. The most striking change takes places in the size of the cerebrum. When the cerebrum first appears in the history of life it is small and insignificant compared to other parts of the central mechanism. But as we pass up the animal scale, the cerebrum becomes larger and larger. First it swells out over the optic lobes, then covers the olfactory lobes and the cerebellum and, finally, in the human organism, it has become the most prominent part of the whole central mechanism.

Development of Accessory Structures.—In the meantime the receptors and the effectors are changing. Original sensitivity to heavy pressure, to chemicals, and to light develops into sensitivity for wide variations in pressure and in degrees of temperature, to chemicals in liquid and gaseous form, to graduated illuminations, and to specific color waves. The effectors become exceedingly fine instruments—the muscles of the eye or of the vocal cords, for example—for carrying out movements adequate to a stimulating object. And set between the receptor and the effector is the great adjustor, the great mediator, the cerebral cortex.

The advantages of the type of nervous system we have just described are too many to set down here. It makes possible a tremendous range of complication in reception and in response. The breaking up of the whole system into units called neurons prevents haphazard diffusion in the spread of neural excitation. Nerve currents now run along definite channels. The resistance at the synapses admits of delayed responses. The great adjustor provides for selected responses. In short, the whole device represents the last word in neural development.

If, now, we regard this extremely brief picture of neural development from the point of view of genetic psychology, and have in mind the principles of psychophysical conjunction and of genetic continuity, it follows that mental life and behavior must have begun as simply as the nervous system and that its history has followed the general pattern set by neural history. That is to say, if we let inference and analogy run their courses, there is no conceivable way of attributing to an organism with the simple effector system, a complex scale of mental life. As receptors improve, however, we may readily speculate as to the range of perceptual experience. Likewise, as the central adjustor improves, we can speculate as to the range of centrally determined and initiated movement systems.

The Development of Perception

As we have already seen there are two large problems in perception, viz., the problem as to the extent of any creature's effective environment and the problem as to the discriminations which a creature may make within its effective environment. The stories of the development of these two phases of perception have many features in common and in order to conserve space, therefore, we shall treat them together. We may say, in general, that as one ascends the scale of life we find (*a*) an ever-increasing range of effective environment, that is, living creatures have learned through the ages to settle their accounts with an ever-widening circle of natural events and agencies and (*b*) we find an ever-increasing ability to make finer discriminations within the environment which the creature has created for itself.

Chemical Discrimination.—Living protoplasm is a chemical compound abiding in a chemical medium (liquid or gas) and it is natural, therefore, that chemical substances should play a large part in determining the behavior of lowly creatures. The amœba is able to distinguish accurately between edible and inedible substances although this discrimination does not always take place until the substance has actually been ingested. Many other substances, however, are reacted to as if the protoplasm of the creature were, itself, a chemical sense organ. At the very best, however, there is not a great qualitative variety in the discriminatory reactions of amœba.

A more complex animal, the hydra, gives definite food reactions distinct from response to mechanical contact. It will distinguish, for example, between fish meat and soft paper balls. It will grasp with its tentacles paper balls which have been soaked in fish juice.

By the time we reach the segmented worms, the chemical discriminations have become fairly well developed, for the common earthworm makes all types of selective reactions to the substances among which it lives. A typical experiment in this field consists of placing across the path of a crawling worm the juices of various ground vegetables, together with a number of chemicals, some of which are known to be injurious or mildly disturbing. These stimuli are offered in a chance order and the discriminatory reactions which follow give the experimenter direct evidence of the earthworm's power of discrimination.

We pass over intervening forms (mollusks, echinoderms, and crustacea) and mention briefly the discriminatory powers of the insects, especially of the ants and the bees. Hitherto the chemical sense has been primarily a food sense, but now appears a qualitative change within the chemical sense itself, a change which we know as taste and smell. It is probable that ant colonies are kept together by a colony odor and there are many reasons to believe that the well-frequented roads to and from a nest are preserved by odors. Likewise chemical traces are thought to aid the solitary forager and there is good evidence to show that larvæ are recognized solely by the colony odor. Ants from a strange colony bathed in juices from crushed ants of the home colony will be accepted by the home colony although it frequently happens that there is considerable hesitation in the reception. The sense of smell in bees is also well developed, and it is thought that the bee recognizes its nest and its nest mates through this channel. There is some evidence that the search for flowers is also directed by the chemical sense; but it is now known that visual factors play a large part, perhaps the dominating part, in this search.

Among the vertebrates the evidence grows in volume that the chemical senses are becoming increasingly refined. This evidence from discriminatory behavior is supported by evidence from the growth of the "smell brain" and the development of the connections between this brain and other centers in the cerebral mass.

Hearing.—The sense of hearing has probably had a comparatively short history. It looks as though the ear had developed out of a primitive sac filled with liquid and containing a few small mineral bodies set in motion by mechanical means. That is, any change in the position of the creature would cause a movement of these small particles and this movement would then become an effective agent in exciting the receptors. This organ was, therefore, an equilibratory mechanism.

It is not until we reach the highest invertebrates that sufficient evidence is got of direct auditory discrimination; but even here it has not been demonstrated that the responses are auditory instead of tactual or mechanical. That is, wave vibrations in the air could actuate the otolithic particles in the equilibratory organs and thus enable the creature to make discriminatory reactions to sounds. Even among the lower vertebrates the auditory organ seems to be essentially an equilibratory mechanism, although in fishes there is some evidence of a reaction to auditory qualities, both to tone and to noise. Among the amphibia auditory discrimination certainly does appear and it develops rapidly as the scale of vertebrates is ascended. Proof of this development comes not only from the nature of the reactions themselves but from the increasing importance of the "auditory brain" and the increasing refinement of the connections between this brain and other nerve centers.

Light Discriminations.—Light was probably of great significance to life very early in its history. As a matter of fact, the chemical action of light is thought to have had no small part in the origin of life and this is the authority men have for the belief that light discriminations are as old and as biologically significant as chemical discrimination.

When a ray of light falls upon the amœba, its movements are immediately checked. Other organisms of the same class discriminate between light intensities, seeking regions of lesser or of greater illumination. It is, however, a change in illumination and not illumination itself that acts as an effective stimulus to these humble creatures. It has been suggested, therefore, that light acts as a mechanical stimulus and not as a visual stimulus among all creatures which do not have a special sense organ for visual stimulation.

This special sense organ appears rather early in the animal scale as a small pigmented spot near the anterior end of certain

Protozoa (Euglena). Light discriminations increase rapidly in number and in delicacy as this pigmented spot becomes elaborated in structure and blossoms out finally as a distinct receptor. Among most of the vertebrates one finds image-forming eyes and this makes it possible for the creature to react not only to the mere presence or absence of light but to the pattern or form of the light stimulus as well.

The comparative ease with which one may trace the development of light discriminations has been offset by the difficulties which have stood in the way of searching out color discriminations. A large number of the lower animals respond differently to various color qualities; but this is not evidence of color discrimination, as can be divined from the discriminations which a color-blind human being makes to an assortment of colored wools. All colors have, in addition to hue, a tint or brightness value, and it has not been adequately proven that the discrimination is not discrimination of light intensity rather than a color discrimination.

The problem has been complicated by the fact that where color discrimination does appear, the colors of the greatest brightness value are chosen in preference to all others. The whole issue is plainly marked in the attempts that have been made to explain the discovery of flowers by bees. In one very interesting experiment the experimenter trained some bees to find honey upon a blue paper rather than upon a paper of any other color. He then placed the blue paper among many grays of every conceivable shade. It was to be expected that at least one gray would be equal in light value to the blue. The bees still found the honey, and this would indicate a specific reaction to blue as blue. The doubt that may be present concerning the color discriminations of the invertebrates is dissipated among the vertebrates. It has been shown that fishes have well-defined talents for color discrimination and from their level to that of man these talents improve in quality.

There is still some doubt about the range of color discrimination. The evidence seems to suggest that blues and yellows become an effective part of the environment before the greens and the reds. This is probably true also in the development of the child. It is interesting to compare this fact with the fact that red-green color-blindness is the most common type of visual inadequacy.

Spatial Perceptions.—The eye is an apparatus which makes possible the perception of size and of form. Animals as low as the mollusks, on the one hand, and butterflies, on the other, can distinguish the size of visual objects. "Two turtles learned to discriminate between vertical lines eight millimeters in width and vertical lines two millimeters in width, and one gifted animal learned to distinguish, first, lines eight millimeters wide from lines one millimeter wide, then between a width of four millimeters and a width of one millimeter, then between four and two, and finally between three and two millimeters. A chick proved equal to a discrimination between a standard circle six centimeters in diameter and one from one-fourth to one-sixth larger. . . . White rats can discriminate circles thirty millimeters in diameter from circles fifty millimeters in diameter and squares twelve centimeters a side from squares one centimeter a side. . . . Raccoons were taught to distinguish perfectly between two cards, one 6½ x 6½ inches square and the other 4½ x 4½, shown successively." [1]

The accurate perception of the form of objects appears in many animals. Bees can distinguish a blue circle from a blue square. The English sparrow and the cowbird both learned to distinguish a card bearing three horizontal bars and one bearing a black diamond from each other and from plain gray cards. Dogs have been taught to distinguish printed letters on cards. "Sir John Lubbock's poodle 'Van' is a familiar example. Van learned to pick out cards marked 'Food,' 'Bone,' 'Out,' 'Water,' and the like, and to present each on its proper occasion. It took him ten days to begin to make the first step of distinguishing a printed card and a plain one; in a month this was perfected and in twelve more days, when he wanted food or tea, he brought the right card one hundred and eleven times and the wrong one twice." [1]

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[1] Washburn, M. F., *The Animal Mind*, 1926 (3rd. ed.), pp. 218-219.

It is possible that spiders perceive depth, for they have been known to jump upon their prey several inches distant. The jaculator fish is thought also to react to distant objects, for it shoots a small drop of water at insects above the surface of a pond and so brings them down. The whole question of depth perception is still in a state of doubt, for "some of the most important conditions of distance perception in our own experience are lacking in the lower vertebrates and in invertebrates. Stereoscopic vision, the appearance of solidity given to objects by the fact that the visual fields of the two eyes combine, thus producing blending of two slightly different views of the object looked at, has been held to be dependent on the partial crossing of the optic nerves on their way to the brain, whereby each retina sends nerve fibers to both hemispheres of the brain. This arrangement does not appear in the animal kingdom below the birds; whatever function it plays in space perception is, then, absent from reptiles, amphibians, fish, and invertebrates. Certainly stereoscopic vision cannot exist in animals whose eyes are so placed that the same object cannot be seen by both, as is the case with most fishes. Hess, by the way, has shown that the monocular visual field in fish is much more extensive than in man. Fish can see objects directly above them. In birds whose eyes are situated too far toward the sides of the head for the same object to cast its images on the foveas or centers of the two retinas, there appears to be a secondary fovea in each eye, so placed as to suggest that it serves binocular vision, while the primary fovea is used for monocular vision." [2]

Learning and Memory

Every living creature is born, as we have seen, possessed of an original nature. It has talents which are not acquired through learning. Life has appeared to move in two directions as far as original nature and learning are concerned. In the one direction original nature (instinct) has become all-important, while in the other freedom from original nature has been all-important. The ant is the best example of glorified original nature, while man is the best example of freedom from original nature. The ant shows little talent for learning; the man shows untold talent.

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[1] See Washburn, *op. cit.*, p. 222.

[2] *Ibid.*, pp. 233–234.

Types of Unlearned Behavior: Tropism.—The tropism is one of the simplest forms of unlearned behavior to be found among the lower organisms. It is said by some physiologists that all primitive behavior can be described as simple and more or less mechanical movements of approach or retreat, or as positive and negative reactions to objects. Under the tropism theory a stimulus operates as an agent in forcing the animal to take a certain position with respect to the direction from which the stimulus comes. That is to say, the animal attempts to orientate itself with respect to an exciting object, the head-end being either toward or away from it. When this position is attained the animal may proceed directly away from or directly toward the exciting object. The bodily movement is supposed to issue from the direct action of the stimulus upon the motor organs on that side of the body nearest the stimulus.

Tropisms have been distinguished by the kind of stimulus arousing the movement. A phototropism is a response to light. Other names, such as rheotropism, chemotropism, geotropism, stereotropism, thermotropism, and galvanotropism refer, respectively, to the movements made in response to currents of air or water, chemical substances, gravitation, surfaces or objects, changes in temperature, and electric currents. The tropism theory has created a great deal of interest among psychologists and biologists, and at least one investigator has sought to make it the basis of all directed or controlled movement, even in the higher animals (Loeb). It is a distinctively mechanical theory of behavior.

The Reflex.—The second typical sort of behavior among the lower animals is the reflex. At the outset we must distinguish two meanings of the word. On the one hand, reference is had not to a type of behavior but to the neural mechanism involved in the production of certain simple movements. In this sense the reflex is a sort of functional unit of the nervous system, the smallest working or operating unit. Almost all of our present discussion, however, has to do with the reflex as the simplest type of response found in animals possessing a nervous system. The tropism and, as we shall find, the instinct, involve an orientation of the whole organism. The reflex, on the other hand, never involves the whole organism. A definite tract in the nervous system is set into function for a fairly limited period of time by a specific stimulus and some local muscular movement runs its course.

The reflex has been a special object of study on the part of neurologists and physiologists and, although we cannot give a complete account of the studies that have been made, we must become familiar with some of the terms that are in common use. Two reflexes are of special interest in psychology, viz., the scratch reflex in the dog and the salivary reflex. The former in the hands of Sherrington has yielded a great deal of information about the mode of operation of the nervous system. It has been found possible to keep alive and well a "spinal dog" whose brain stem and cerebrum have been separated from the spinal cord. A great variety of experiments can then be performed on the integration of reflexes. A single stimulus of moderate intensity in the region of the thorax will bring about a scratching movement. The movement is definite and lends itself readily to measurement. Variations in the intensity of the stimulus and its location (on one side, on both sides, over an area, etc.), cause variations in the movement of the hind limbs which, taken with facts of neurology, brings out the precise mode of operation of the lower nerve centers. Combined reflexes, antagonistic reflexes, delayed responses, discharge into a final common path, and other phrases of the same kind are ways of describing neural operation. We have already seen how these facts can be put to work in understanding the operation of higher centers (see p. 157).

Psychological interest was first attached to the salivary reflex by Pawlow, a Russian physiologist, who distinguished after a series of clever experiments between conditioned and unconditioned reflexes. It is well known that some stimuli will, without previous training, arouse definite and rather specific responses. The taste or sight of food, for example, usually excites an increased flow of saliva, or a sudden increase in the intensity of light will cause a contraction of the pupil in the eye. Such reflexes are known as unconditioned reflexes. Now Pawlow discovered that if some other stimulus is presented to a dog along with the stimulus adequate to an increased flow of saliva and if the simultaneous presentation of these stimuli is repeated, there finally comes a time when the secondary stimulus alone is sufficient to arouse the flow of saliva. That is to say, a new stimulus can be grafted to another response, thus modifying the reflex. Such reflexes he called conditioned reflexes.

The possibility of conditioning a reflex has placed a valuable method in the hands of the comparative psychologist for determining the ability of animals to discriminate between objects. Suppose, for example, that the adequate stimulus to withdrawing the foot is an electric shock. Now the ringing of an electric bell will not excite such a reflex movement of the foot; but if the bell is rung and the foot is at the same moment excited by an electric current, and if these two conjoined events are repeated, it turns out that the bell alone will finally induce reflex movements of withdrawal. There has evidently been a substitution of one stimulus for another. If now, a bell of a slightly different pitch is used, the reflex movements may not appear. Obviously the animal used in this experiment can distinguish pitch differences of certain demonstrable magnitudes. The method here applied to sound is probably useful in any sense department.

Instinct.—The word instinct has come to have two widely divergent meanings in psychology. It refers, in the first place, to a kind of impulse having dynamic power enough to drive an organism into action in racially predetermined ways. Thus we have the phrases "instinctive drive," "instinctive urge," etc. The word refers, in the second place, to a distinctive behavior pattern. This is the meaning we shall put into the word in what follows.

An instinct is *not* the alleged ability of animals consciously to forecast and to prepare for a coming event in a way that is beyond the range of reason. Neither is instinct the ability to act telepathically,—that is, to act with reference to or to have knowledge about, objects or persons far away. Popular literature is so full of trash about the "intuitive" knowledge of animals, especially of dogs, that in the popular mind the whole scientific issue has been befogged and distorted. Novelists like to make a good story, and owners of pets are fond of picking out the more obvious and striking types of behavior and interpreting them in the light of human experiences.

In physiology the word instinct stands for a kind of inherited neural organization. That is to say, the physiologist places emphasis upon the fact of inherited tendencies to behavior rather than upon the behavior itself or upon the end gained by the behavior. It will be recalled, from our survey of the principles of nervous function, that many behavior patterns are guided in their temporal course by a determining tendency, or by an organization in the nervous system which directs the action or emotion consciousness toward a definite goal. The instinctive organizations in the nervous system are probably the most deeply rooted determining tendencies the body possesses. They serve to guide the temporal organization of behavior patterns over relatively long periods of time.

After the following formidable definition we shall give an illustration of a typical instinct and then relate the illustration to the definition. An instinct is an inherited and a specific though complex type of behavior which is aroused by a definite situation and which, at appropriate intervals in the life history of the organism, runs its course without conscious guidance or direction. If a cat is brought, for the first time, near a cage containing white rats, the rats will become frightened, retreat to a corner of the cage, huddle together in a rather tense heap, and remain in that position for an hour or more after the cat has been removed. They will not behave in this manner before an object in the form of a cat nor to the cat if it is within a glass jar. They will respond indifferently to a cloth that has been rubbed over the cat's fur, but they will not respond to any detached portion of the cat, save possibly the nose and mouth. They will not so respond to a large variety of odors or chemical substances, nor to other animals such as the dog or the rabbit. They may move in a similar manner to very loud sounds. The behavior of the rats is fairly constant from individual to individual. The body is frequently tense or at least very quiet; there may be trembling and a peculiar whining is often heard. There is also evidence of profound organic changes and marked changes in respiration and heartbeat are easily observed.[1]

Here, then, is an instinctive performance. How does it exemplify the definition? In the first place, the instinct is an inherited mode of response. It can be shown that white rats which have never been near a cat will act in the manner we have described. The tendency issuing in the performance is no doubt firmly laid in the nervous system. In the second place, the instinct is a specific type of behavior. In other words, the pattern is always about the same from individual to individual. Neither sex nor age seem materially to modify it. It is, moreover, a dominating sort of response. Rats which are mothering young will leave their nests and retreat in fear; and the response stands prior to feeding, to mating, to sleeping, and to exploratory movements. In the third place, the instinct is a complex type of behavior. It involved, in this case, the whole organism. The behavior pattern is complex both temporally and in cross section, for the fear reaction is accompanied by respiratory and cardiac and general systemic changes. These changes persist over a long period of time. In the fourth place, the instinct is aroused by a specific situation. In our illustration, the odor of a living cat seemed to be the exciting agent. Vision and audition were not involved. In the fifth place, there is no evidence of conscious direction in the animal's movements. It seems to be under the spell of the odor and the response is so immediate and so striking as to indicate that its roots lie deep in the neural organization of the animal.

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[1] Griffith, C. R., "The Behavior of White Rats in the Presence of Cats," *Psychobiol.*, 1920, Vol. 2, pp. 19–28.

When we take instincts in the large, certain other characteristics appear. They can, for example, be modified. That is to say, the stimulus exciting them can be changed, and some of the responses can be modified; but the central phases of the instinct are pretty well fixed. Many instincts are timed. They run their course only at certain intervals in the life history of the individual. They are, moreover, cyclic. Mating seasons come in the early spring, to be followed by nest building, brooding, and feeding.

A great many attempts have been made to classify the instincts but none is adequate. Published classifications make use either of the end the instincts subserve, of the movements that accompany them, or of the kind of conscious experience they condition. The classifications are inadequate, perhaps, but the general features of a typical instinct are, it is hoped, fairly clear.

Acquired Modes of Behavior.—No animal runs through its life history without having had even its instincts modified in the running. "An insect that lays her eggs in a place where she never sees them hatched must always do so 'blindly'; but a hen who has already hatched a brood can hardly be assumed to sit with perfect 'blindness' on her second nest."[1]

A precise definition of "profit from past experience" is a hard matter. If the phrase is made liberal in its meaning the very lowest animals can learn. But in such cases profit is due primarily to temporary changes in the body. For example, the second reaction to a stimulus may be more violent because the first has just taken place. The first seems to have left the body of the animal in a state of heightened tonus. There is no reason to believe that this effect is permanent, but it does show, in a large sense of the phrase, that present behavior may be modified by previous behavior. Again, the second stimulus or a repeated stimulus may come finally to have no influence upon an animal. It has been shown experimentally that this sort of change does not depend upon fatigue but upon sensory adaptation (in lower animals) or upon lapse of attention (higher animals).

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[1] James, W., *Psychology*, 1890, Vol. 2, p. 390.

Changes due to past experience must ordinarily be more permanent than changes of the kind just described. They must also take place more rapidly than the growth of muscles or of other tissues if they are to fall under " learning." In other words, true "profit from past experience" must represent a functional change in the nervous system, a change which rests presumably upon variations in the resistance at the synapses.

Types of Learning.—Repetition is the most direct means of effecting these changes. Under repetition two things may happen: (*a*) useless movements may drop out; (*b*) discrete movements may be linked together to form a series. In learning the maze, for example, the rat on the first turn runs into every blind alley and retraces its pathway many times. Gradually the useless movements are dropped and the animal learns to run so that each step takes it by the shortest route to the food box. In escaping from a puzzle-box many random movements are made. Unsuccessful movements are rapidly dropped while the correct movement is stamped in and shortly the animal does only the necessary things to get out. The causes of selection (pleasure, pain, success, punishment, etc.) are still a matter of speculation.

If the conditions of the experiment are changed repetition leads to the formation of a series of movements. The maze illustrates this type of learning as well. There are experimental reasons to believe that the rat does not see, hear, feel, or smell its way through the maze. On the contrary, a certain number of movements are made and some of these get themselves put together in a chain or a series. "All the evidence indicates that when a rat has thoroughly learned the maze, its movements have become organized into a system such that the sole requisite stimulus for the performance of one movement is the kinæsthetic excitation resulting from the preceding movement."[1]

Two other forms of profit from past experience have been described. Bees, ants, and homing birds are thought to be guided by familiar landmarks. Wasps are said to recognize visual objects near their nests. Ducks and geese are known to follow certain pathways year after year. It is not known how much consciousness is involved in recognition of this sort, but the behavior of all homing animals is an argument for profit of a certain kind.

"Memory Images."—Learning among animals approaches nearer the human level when we come to signs of a "memory idea." There can be no doubt that animals do possess the power of learning in the sense of reacting differently to an immediate stimulus because of their past experience with it. But this ability is not, in and of itself, evidence of the existence of the use of a memory idea—of images referring to a past object. It is alleged that animals do not use such images because of the trial and error method of learning. Errors are dropped out gradually, while in the human subject the elimination is immediate or very rapid. It is also urged that animals are not able to imitate one another during the absence of the one to be imitated. Furthermore, most animals must react immediately to a stimulus, if they react at all. Other factors, such as the nature of the errors that are made, and the dependence of the organism upon instinctive performances, lead to the conclusion that memory images are fairly rare in the animal kingdom.

Experimental evidence is more conclusive. Let us suppose that a white rat has learned to discriminate between lights of different intensity so that it always goes to one box of four for its food. The food box is brightly illuminated and its position with reference to the others is constantly changed. Let us suppose further that the animal is held behind a wire screen while the boxes are properly illuminated for one minute. All the lights are then turned out and after ten seconds the rat is released. If, now, the rat can use memory images it ought still to locate the food box in a majority of the trials. It fails to do so. That is to say, the white rat cannot or at least does not show evidence of the persistence of an imaginal process for even so short a time as ten seconds. This method, which is known as the delayed reaction method, has been applied to many animals without final but with suggestive results.

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[1] Washburn, M., *The Animal Mind*, 2d ed., 1917, p. 280.

Experiments show that the maximal interval which may separate the stimulus from the response is, in rats, one to five seconds, racoons, ten to twenty-five seconds, cats, sixteen to eighteen seconds, dogs, one to three minutes, a child (1¼ yrs.), twenty seconds, (2½ yrs.), fifty seconds, (5 yrs.), probably as much as twenty minutes, apes (Köhler), twelve or more hours.

Learning Tricks.—A word should be said about the learning of complicated tricks. It is usually the vaudeville performances of animals which strengthen the common belief that they are possessed of complex and even mysterious powers. The method ordinarily used in training animals involves the same factors as does their laboratory treatment. Advantage is taken of some instinctive tendency in the animal, often the movements made in searching for food. By repetition the white rat soon learns to run through a maze for its food. Suppose now that the course of the maze is gradually complicated and that in addition to running the maze the rat must climb a wall, then jump a certain distance, and so on through many variations. It thus lies within the power of the experimenter or of the trainer, either to make the rats go through the whole series of movements before food is reached, or gradually to eliminate the earlier performances and finally, through a series of accretions, to arrive at an achievement quite distinct from the original behavior. This is the process ordinarily used by trainers. A great deal of time is saved by punishing wrong behavior in addition to rewarding right behavior. A given situation is gradually made more and more complex and, as the early stages drop out, the performance seems to represent real ingenuity on the part of the animal.

Development of Prevision

Learning and memory are, as we have found, ways of extending the effective environment of an animal backward in time so that the responses of this moment may be made in terms of what the organism has already accomplished or experienced at some previous time. But the effective environment of a creature may be extended into the future as well as into the past and this is what we have elected to call prevision (rather than imagination). Prevision means making preparations now or assuming attitudes now in preparation for an event that is yet to come. This talent is probably an elaboration of that simple form of expectancy which is found in so many of the higher animals by virtue of which a perceived object points toward a "next" event. The dog, for example, that awaits with a certain eagerness or expectancy the moment when we shall pick up the gun illustrates the type of behavior which we mean to emphasize.

It is said that this question of prevision waits upon the question as to whether animals can make use of what are called "free memory images." Precise experiments upon the matter are wanting. It will not do to appeal to those forms of "instinct" in which it appears that animals are prevising a long winter, a cold snap, or favorable conditions for the hatching of eggs. Students who are tempted by the field of animal psychology would do well to make this group of problems their first choice for it has been a neglected field.

Development of Attention

No creature responds, as we have seen, to the whole of its effective environment with the whole of its motor mechanism. There is always selection either because of the nature of the stimulus or because of conditions internal to the organism.

That is, there are conditions which determine the prepotency of a stimulus. Here, too, there are a very large number of studies and these seem to point to the generalization that growing intelligence means a growing ability to release oneself from the prepotency values of the environment and to make use of tendencies toward prepotency which are built up within the organism itself.

Prepotent Stimuli Among the Lower Animals.—Intensity of stimulus in and of itself appears to be a factor determining prepotency among all animals at almost any time. Outside of intensity, the following factors may be mentioned: (*a*) The influential stimulus is often the stimulus that is first upon the field. Paramecium resting upon a vegetable or a piece of paper will not respond to a slight blow as it ordinarily would. That is, the intensity of the blow must be greater if it is to overcome the reaction pattern already present. Thigmotactic subjects will not respond to heat until a higher temperature is reached than that necessary to cause movement when the creature is freely swimming. Earthworms will not react negatively to light while mating. Here, however, the prepotency of mating may be determined not only by the priority of the light stimulus, but by the biological significance of the mating situation. Earthworms will not ordinarily begin mating, however, when the light stimulus is first upon the field. (*b*) A summation of stimuli will often become prepotent when a single stimulus is not enough to bring about response. It takes repeated taps upon the walls of the sea anemone to cause it to detach itself and move away. (*c*) As a rule, it is *change* of stimulus and not merely stimulus itself that becomes prepotent. Worms may be gradually heated and some may even die without perceptible reaction, but when the temperature is suddenly changed the reaction may be extremely violent.

Prepotency Determined by Internal Factors.—Evolution of the power of attention has meant an expansion of the internal conditions for insuring prepotency rather than any notable changes in the external conditions (except such as we have already described as expansion of the environment and refinement of discriminatory power within the environment). We have space for only a few of the many conditions under which internal factors favor prepotency.

First and foremost one must mention prepotency that is guaranteed by the innate preferences of the nervous system. We do not have to call these innate preferences instincts. We remark only the fact that nature has endowed animals with certain preferences and these preferences favor the prepotency of some objects rather than others.

In the next chapter we shall see how some objects have gained an habitual attention value through learning. Objects and situations which, in the experience of the individual, have come to mean something for the individual, achieve prepotency. Attention or prepotency gains its highest significance for the organism when incipient or covert movement systems acquire ascendancy and maintain themselves until effective action can result. Here we touch upon memory and upon all of the neural patternings that may accompany thinking. Miss Washburn describes the facts as follows: "The highest grade of attention, the final triumph of vital importance over mere intensity of stimulation, is to be found where the focus of attention is occupied by an idea or train of ideas. When a process purely centrally excited holds the field and makes the individual deaf and blind to powerful external stimuli pouring in upon his sense organs, then he is superior to the immediate environment at least. This form of attention occurs, probably, only when the vital importance of the idea attended to has been learned through that most rapid form of individual acquisition of experience which involves the revival of the past in idea." [1]

PROBLEM-SOLVING

Genuine problem-solving is a late acquisition on the part of life. The clearest evidence which we have takes this talent back only to our nearest biological relatives, viz., the apes. Psychology is indebted to two men for information in this field, to Köhler and to Yerkes.[1] We have space for a bare outline only of the experiments and of the facts.

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[1] Washburn, M. F., *The Animal Mind*, pp. 346–347.

At a simple level, problem-solving means a more or less sudden and unique resolution of a difficulty, independent of trial and error. Rats do solve the problem of the maze in the sense that after a large number of futile wanderings the correct path is discovered. It may be, however, that the maze problem is a human problem and not a rat problem. The starting point of current research upon the problem-solving talents of animals has been the selection of problems which are upon the level of the animal concerned, that is, problems that can be comprehended by the subject. Suppose that a bit of fruit is beyond the reach of an ape. Will the ape paw the ground and scream futilely at the bars of its cage, as a dog would do, or will it find a way to get the fruit? Both the dog and the ape might seek to escape through a back doorway and thus get around the bars, but only the ape is able to *see* a stick in the cage as an instrument or a tool for reaching out to the food.

Experiments in Problem-Solving.—Some of Köhler's experiments run as follows: Food is placed outside of the cage within arm's reach, but a box stands on the inside of the cage and in the way of the ape. The ape moves the box and thus gains the fruit. Fruit is hung from the ceiling at a height too great to reach by jumping. Within the cage are two or three boxes. The ape solves the problem by piling the boxes one upon another thus gaining his reward. One of Köhler's subjects had the happy thought one day of fitting two rods together in order to make a longer stick. The single sticks were too short to reach the goal. In one case, the solution of the problem meant that the ape must push the fruit away, that is, toward another grating on the opposite side of the cage, in order that it could be reached after the ape had passed around the cage.

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[1] Read, Köhler, W., *The Mentality of Apes*, 1925. Yerkes, R. M., *Almost Human*, 1925.

Köhler has explained these achievements in terms of what may be called "insight." There is no trial and error in these experiments. There were, as a matter of fact, some facial expressions and some bodily postures which appeared to betray doubt, perplexity, and reflection. There were also sudden behavior patterns which seemed to mean "Ah! now I have it!"

If, in the process of further discussion and experimentation, it should be decided that these experiments actually reflect insight or thinking, we shall have added an important chapter to psychology. Our curiosity will then push us to similar experiments upon creatures even lower in the scale. The greatest uncertainty surrounds the experiments that have already been performed. In some of Thorndike's experiments with cats it has been shown that cats, too, made sudden escapes from the puzzle box. Sudden drops in a learning curve which otherwise represents the results of trial and error learning have been explained as the result of chance; but there is now a disposition to examine some of these curves and the problems out of which they come a little more critically with the hope of defining the limits of this particular moment of intelligent behavior.

EMOTION

Inferences concerning the tonus of bodily reactions and concerning the fundamental attitudes of animals toward objects come almost entirely from the expressive movements which accompany their emotional life. Of these expressive movements there is no lack. Darwin was so impressed by them that he devoted a special book to their discussion.[1] Attitudes of attack, of fear, of sexual pursuit, of pleasure are common enough in our chief household pet, the dog. But similar attitudes are found in almost all living creatures. Among the invertebrates positive and negative reactions to extremely favorable or unfavorable stimuli carry a quality which might be called emotional. That is, the intensity of the reaction is so out of proportion to the intensity of the stimulus that one may be justified in inferring an emotional attitude on the part of the creature. It has been suggested, for example, that the swarming of bees is an expressive way of manifesting "joy." Studies on the minute behavior of these creatures during swarming suggests that the behavior patterns owe their form and intensity to more than ordinary conditions of bodily tonus.

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[1] Darwin, C., *The Expression of the Emotions in Man and Animals*, 1890.

Experiments in Emotional Reaction.—Our best information concerning the emotional life of animals comes from Köhler.[1] This investigator found and was able to describe, among other moods and emotions, anxiety, sadness, anger, rage, disillusionment, discomfort, moody depression, joy, jealousy, and envy in the daily life of his subjects. One creature expressed its displeasure by the waving of an uplifted hand. Greater impatience was expressed by striking its hand against the ground. The deception of another subject issued in violent tramping upon the ground and striking the ground with the fists. Joyful expectation was expressed not only in the face but by a posture of the head and of the whole body. Even some of the finer attitudes which we call sentiments were observed among these creatures.

Such sketches of isolated animal groups are not, of course, a developmental account of the origin and growth of the mechanisms involved. This is a chapter of animal psychology, however, which is gaining in attention.

DEVELOPMENT OF ANIMAL PERSONALITY

We know practically nothing of those attitudes and total behavior patterns which would mark personality differences among animals. That there are such differences no one will doubt who has had any dealings with household pets, farm animals, or zoölogical gardens. We speak of surly and of kind animals, we speak of devoted and of untrustworthy animals. Thus we pay homage to the fact of personality differences in the creatures below us, but our knowledge in this field is purely anecdotal. It may be that personality or character is a trait which becomes defined only when the environment of a creature is highly socialized, as in man. The surliness or devotion of an animal would, then, be a product, in part, of our tendency to humanize the animal and, in part, of its normal emotional and moody attitudes. But these attitudes may become habitualized and stabilized just as they do among human beings, and in this sense we may be justified in searching more diligently for character and personality traits of the lower forms of life.

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[1] Köhler, W., *The Mentality of Apes*, 1925.

Do Animals Have Minds?

In spite of the obstinate attempts that are now being made in psychology to account for the whole range of animal behavior in terms of stimulus and situation, on the one hand, and behavior patterns, on the other, our fancy wanders every now and then, to the question: "Do animals have a Mind?" It is not unreasonable to suppose that they enjoy some sort of mental life, a mental life commensurate with their position in the scale of life, the conditions of their sense organs and brains, and the number and range of their behavior patterns. But suppose we *assume* that human beings possess a Mind which is an effective and more or less independent agency in the creation of behavior patterns and in the formulation of thoughts. What, then, would be the line of argument and the limits of speculation as to the Mind of the lower animals?

The Argument from Analogy.—It is a commonplace that we cannot directly perceive the mental life of our neighbor or the mental life of animals. Prior to reflection we are usually willing to affirm animal mentality on the same grounds as we affirm human mentality. When pushed for a critical answer we fall back upon an argument from analogy which runs something like this: "Why of course my neighbor has a mind; he reads the same books as I; he talks with me and I understand him and he understands me; he acts in general as I do. Why, 'the question is foolish.' Of course all people have minds." If we were more critical we might refer to the similarity in structure between different human nervous systems and to the literature, art, and science which seems to depend upon or presuppose the existence of other minds.

The argument from analogy, then, is the authority men have for postulating Mind in animals. The process is always one of inference. We cannot see our neighbor's Mind, but we can see what he does. So with animals; we cannot see their Minds, but we can infer Mind from their behavior and from certain other materials. The animal, we say, appears to behave intelligently, *i.e.*, its movements are either adaptive or are modified under previous experience. An animal is said to respond adaptively when it seems to be particularly fortunate in getting out of a difficult situation. It is obvious that a machine or a brick or a telephone pole cannot approach an obstacle and then devise a way of getting around it. Animals do just this sort of thing. They are constantly overcoming obstacles; they are repeatedly adapting themselves to new situations. We humans, being past masters in the art of "adaptation," make much of this behavior on the part of lower organisms and sometimes interpret it too liberally.

Learning as Evidence of an Animal Mind.—The ability of animals to learn has done much to convince men of the existence of an animal Mind, but this fact is not without antagonists who say that inanimate objects may profit by past experience in the same manner. For their chief illustration they relate how an iron bar "profits by experience" when it tends to bend in the same place under repeated stresses. There are, however, certain distinctions to be drawn in this case. In the first place, we are dealing with two fundamentally different orders of existence. Life manifests properties that do not fall to lifeless objects. In the second place, the profit accruing to the living organism, especially in the higher species, is more flexible and pliable than in the case of the iron rod.

Most psychologists, therefore, are inclined to attach considerable importance to this criterion of the existence of an animal Mind, but inferences must always be drawn with care. It has become a law in animal psychology that an event must not be explained by a more elaborate hypothesis or by more assumptions than are actually adequate to the facts. This principle we have already come to know as "Lloyd Morgan's Canon." It reads as follows: "In no case may we interpret an action as the outcome of the exercise of a higher psychical faculty if it can be interpreted as the outcome of the exercise of one which stands lower in the psychological scale."

This principle is, as we have suggested, a special case of a general scientific doctrine known as the "principle of parsimony." It enjoins upon any investigator the desirability of using as simple an explanation as will actually cover the facts. At any rate there is probably less danger of misusing such a principle by explaining too simply than there is of anthropomorphizing animals and over-explaining the facts. Many of the facts of animal psychology can be explained without appealing to any sort of mental life, to say nothing of a Mind, but the virtues of the principle must not lead to its ruin. The animal psychologist has proceeded with care and, for the most part, his explanations and inferences are probably close to the truth. At least he avoids anecdotes; he trusts, first of all, in experiments.

The Comparative Equation.—Proceeding in the manner we have indicated, some psychologists have become fairly confident that animals have Minds. They are, furthermore, fairly sure of the "size" and talents of the Mind which animals enjoy. This assurance comes through the application of the comparative equation which states that the Mind of any animal is a function of the complexity of its general physiological structure, but principally of its nervous system. If we let M represent the Mind, B the behavior, and NS the nervous system of the human organism, and if m stands for the Mind of the animal concerned, b its behavior, and ns its nervous system, the equation will read:

$$\frac{M}{B+NS} = \frac{m}{b+ns}.$$

The only unknown factor in the equation is m, the Mind of the animal. The equation ought to be solvable for the single unknown. When properly reduced, it states that the Mind of any animal is a function of its nervous system and behavior in particular and of its gross bodily structure in general. The equation gets its value from two principles we have already discussed, viz., the principle of *genetic continuity* and the principle of *psychophysical conjunction.* It will be recalled that the former owes its origin to Darwinism or to the belief that all life is related. The principle would suggest that, since Mind appears as very complex at this end of a developmental series, it must have begun at the other end as simply as have the body and the nervous system. It is thought inconceivable by many that a thing so qualitatively unique as Mind should have made a sudden appearance at any point in the line of continuous bodily evolution. The principle of *psychophysical conjunction* affirms that Mind and body always appear together. We have already reviewed the facts upon which the assertion is based. The principle can now be extended to the nervous systems of lower animals where the fact has been established that nerve structures of essentially the same sort appear in all animal forms save the very lowest in the scale; but even among these, certain tissues fulfill the same offices.

It is obvious, of course, that speculations about the mental life and The Mind of the lower animals is a psychological game rather than a mode of research. One may say, "If this animal has a mind, it must be composed of such and such processes which appear in organizations of such and such complexity," but the whole game rests upon the "if." Such speculations help little in understanding the behavior of living creatures and if the doctrine of psychophysical parallelism is a thoroughgoing doctrine there is little to be gained from puzzling out a mental life which cannot be rendered by or translated into verbal terms.

CHAPTER VII

THE GROWTH OF INTELLIGENCE IN THE HUMAN CHILD

Introduction.—The human infant has been so immortalized in poetry and in romance and its capacities so distorted in description that sound knowledge concerning the origin of its intellectual life was long delayed. We have already seen how it came to be taken for granted, especially among religiously minded people who were forever identifying the intellectual traits of animals with metaphysical beliefs about the existence of souls, that the mind of the infant was but a small edition of the mind of the adult. Such a supposition led to distressing arguments concerning the precise moment at which the child was endowed with its mental life. On the one hand, there were those who believed that the precious gift came precisely at birth, while others supposed that conception or the first-felt movements of the embryo marked the incoming of the soul. As a matter of fact, we shall find that all such arguments are meaningless.

If we were to believe poets we would not only have to admit that the intellectual talents of the child are in some sense a copy of the talents of the adult, but that the child has certain talents and experiences which are foreign to the adult. Many have believed, for example, that the child comes to earth harboring reminiscences of the world it has just left, and that traces of these memories are to be seen in the depths of eyes that, prosaically enough, are not yet possessed of a functionally active iris reflex.

The facts which we are about to review make it clear that the infant is not a small edition of the adult. They show, moreover, that the mental life of the child is not the mental life of an advanced animal. The logic of evolution might suggest that, because of the developmental relations between man and the lower animals, the intellectual talents of the child must represent a little higher stage of development than is to be found in subhuman forms,—this and nothing else. We shall find that this is not the case. The intellectual talents of the child have their own history and are not to be conceived as simple quantitative extensions of the intellects of animals.

This emphasis which child psychologists place upon the unique qualities of the infant intellect is not to be taken as a denial of individual and racial parallels. The parallels stand, but uniqueness also stands. The social factor in child development is only one of the things that makes the process unique.

The Functional Development of the Embryo.—An adequate account of the physiological and, in particular, of the neurological development of the embryo would take us too far from our immediate task. We mention only such facts as will give a broad perspective and such as we may need later. Like other animals, the human being begins his existence as a distinct individual subsequent to the conjunction of a male and female germinal cell. The cell resulting from this conjunction divides rapidly into two, into four, into eight cells, and so on, until all count is lost, for the number runs upward of 2.65×10^{13}. The mass begins shortly (two weeks) to take shape and under the microscope one may see that the forerunners of some of the commoner adult organs have made their appearance. The muscles declare their functional independence by movements which the mother may experience as early as the fifth month. The receptors are practically complete long before birth, the eye, for example, by the end of the fifth month and the ear by the end of the sixth month. Muscular movements which begin during the fifth month lead one to believe that parts at least of the great central adjustor are functionally complete. Certain facts suggest that although the brain, under ordinary inspection, appears to be fairly complete at birth, large parts of it, nevertheless and especially of the new brain, are not functionally ready. For example, large parts of the cortex are not medullated, that is, they have not been covered with a fatty sheath which is thought to furnish insulation as well as nourishment. This process of insulation is carried to completion during the first few months after birth.

The old brain is probably well developed at birth. Edinger and Fischer have described the behavior of a child which was born without a brain, and dependent therefore upon more ancient nervous structures.[1] The child, which lived for nearly four years, remained almost motionless during its entire life, for its behavior was limited to a few simple physiological reflexes. The new brain, a structure acquired relatively late in the history of life, appears to be the special organ of intellectual life.

The Meaning of Intellectual Growth.—When we say that intellect grows or develops we mean to say that we can pass an increasingly favorable judgment upon the average child as he traverses the path from physiological infancy to physiological adulthood. We are passing judgment upon his ability to get on in the environment which he creates. Intelligence is thus a broad term, and it would be convenient if individual development could be described in simpler terms. Apparently it can. We have found it possible to describe getting-on from several points of view and these moments of intelligent behavior offer a way of marking progress in partial talents before we attempt to mark progress in general talent. We shall indicate briefly some of the genetic problems of child psychology that touch upon perception, attention, learning and memory, emotion, imagination, thinking, and personality. Our method here, then, is the same as was adopted in considering the development of the intellectual talents of the lower animals.[2]

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[1] Edinger, L., and Fischer, B., *Arch. f. d. ges. Physiol.*, 1913, 152.

[2] Read Koffka, K., *The Growth of the Mind*, 1924; Hollingworth, H. L., *Mental Growth and Decline*, 1927; Gesell, A., *The Mental Growth of the Pre-School Child*, 1925; Stern, W., *Psychology of Early Childhood* (tr. Barwell), 1924.

Development of Perception

Sensory Discrimination in the Infant.—The movements of the embryo have been explained as having reference to the growing functional activity of the brain. It is barely possible also that some of them, especially toward the end of intra-uterine life, are called forth by gross changes in illumination which may penetrate the body of the mother, by the conduction of sound waves through the tissues, and by the pressures which are exerted upon the embryo. Save for the sudden invitation to make far greater differential responses subsequent to the sudden changes of environment coincident with birth, there is no reason to suppose that the infant is instantaneously and miraculously endowed at that time with intellectual talents of higher orders. The perceptual talents of the newborn infant are of a very low order. Only after several weeks can it discriminate between variations in light intensity. The discrimination of colors has not been confirmed as appearing earlier than the third month (gray *vs.* not-gray) and many observers put color discrimination as an achievement appearing as late as the sixth month (discriminations within the not-gray, *i.e.*, the color series). Reactions to noises and to tones of moderate intensities appear between the fourth and tenth days, although accurate discrimination between different pitches does not appear until some time later. Auditory reactions are probably delayed by a fluid which remains in the ears for several days. Accurate localization of sounds does not appear before the second month and for some infants, at least, much later. Differential reactions to taste and smell have been confirmed by many observers as taking place the first day. All forms of pressure produce discriminable reactions within the first hour. Certain types of painful stimuli are not effective until later.

It thus appears that the infant creates its environment at a fairly rapid rate. That is to say, it creates the general boundaries of what is going to be its effective environment. The process of acquiring fine discriminations within these boundary limits goes on much more slowly. By the third year, however, excellence in this trait is reached and future intellectual development must be found in some of the other phases of intelligence.

It will be instructive to ask how experiments upon the powers of discrimination of small infants are carried out. In one such experiment, the experimenter used milk bottles blown out of milked glass and differing in shape from one another but equalling one another in area. One bottle was circular, another square, another in the form of a diamond, and still another in the usual form. Milk is put into one of the bottles, say the round one, and all four are placed in front of a six-months'-old infant. The infant reaches for successive bottles until the milk is found. On the next occasion the position of the round bottle with respect to the others is changed and again the infant must search for its food. It is obvious that if a six-months'-old infant cannot discriminate between these several forms it will never learn to find its milk except by trial and error. The experiments show, however, that infants of this age can make such discriminations and can thus learn to select the right bottle at the first trial. This experiment illustrates how one goes about it to perform experiments of this type upon very small children.

Learning and Memory

The child moves onward from infancy to adulthood partly because of a normal process of maturation. That is, along with the simple maturing of bodily organs and perhaps of the nervous system (at least of the new brain), there goes a simple maturing of certain types of neural organization. If the child is not born with certain precise instincts it is certainly true that more elementary modes of behavior lend themselves to incorporation in certain behavior patterns rather than to others. In many of the early performances of the child it is extraordinarily difficult to separate the innate, the maturing, and the acquired components of the whole. We say, for example, that the child learns to walk, but there is also some evidence to show that if a child at the walking stage were not permitted to walk there would still be some learning due to the maturation of the muscles involved, and perhaps also to the maturation of the neural patterns concerned in the innervation of the muscles.

At any rate, learning is the most important factor in bringing the child to adult levels of intellect, and all learning is based upon or begins with original nature plus maturation.

Original Motor Equipment.—One of the clearest indices of inherited motor equipment is a simple performance called the grasping reflex. Any sort of object placed upon the palm of a newborn infant will excite this reflex. The stability of the reflex is suggested by the fact that all newborn infants, save about two per cent, can hold their own weight for an appreciable period of time. The neural tendencies issuing in this simple performance seem to persist in the child about one hundred and twenty-four days, after which time they disappear and the subsequent behavior of the child is such that there is no indication that a grasping reflex had ever been present.

Reaching activities begin about the hundredth day. With a little practice they readily become modified into performances more serviceable to the child; and by the one hundred and fiftieth day the child may be actively using its arms in conveying substances or objects from a reachable distance to its lips. Curiously enough, the infant will not often reach for an object much over twenty inches away, although the object may be fixated and followed as it is moved about the room.

Right and Left-Handedness.—Right or left-handedness is an acquisition that has seriously concerned the psychologist for a good many decades. Anatomical and physiological facts indicate that dextrality may have been created by the same conditions that produced speech. At any rate, the use of the hand, like the use of the vocal cords, has played an important part in the history of intellect and the description of the ontogenetic development of handedness has become an important question.

On the one side, it is urged that dextrality or sinistrality are hereditary and, upon the other, they are alleged to be acquired

(Watson). The facts are complicated by the observation that children "normally" left-handed but who have been made to write with the other hand frequently pay for the change by a tendency to stammer or by other vocal disturbances, and by a certain emotional instability. Several other theories to explain the origin of right and left-handedness have been advanced. Successively, dextrality has been laid to natural inheritance, to the left-handed position of the heart, to a greater supply of nerve force because of the earlier development of the brain upon one side, to variable blood supply due to the position of the aorta, to the respiratory functions which produce a mechanically superior efficacy of muscles on the right side, and to the center of gravity of the body. So far as the facts appear at present dextrality is probably hereditary. The definite appearance of right-handedness or left-handedness may fall anywhere between the seventh to the fifteenth month. Ambidexterity, or the ability to use both hands with equal ease, has been noted as early as the first year.

Eye-Movements.—The eye-movements of a child are exceedingly important for they, too, bear a close relation to its subsequent mental achievement and development. During the earliest days of life the eye-movements are slow and much like the tropic responses to light of many lower organisms. Soon, however, this sluggish movement gives way to a more definite mode of fixation. After a short time objects are focused accurately, showing that the ocular muscles are slowly maturing. Complete ability to fixate objects appears about the one-hundredth day. Prior to this time the eyes move preferably in a lateral direction, but afterward they will follow a complete circle.

Other reflexes have been studied with results of a similar nature. The Babinski reflex, for example, consists of the downward fanlike movement in the small toes and the upward movement in the large toe excited by touching the sole of the foot. This reflex is said to have a certain relation to the functional integrity of the central nervous system and is frequently used as a means of diagnosing pathological conditions of the pyramidal tract in the brain (lack of medullation?). The Babinski reflex appears very early, but disappears at about the sixth month except in pathological cases. It is, however, very irregular in its appearance and disappearance.

The general development of the nervous system and the progressive organization of muscular movements are indicated by (*a*) the ability of children to sit alone, and (*b*) by the completion of walking habits. Sitting alone for a few moments may occur as early as the one hundred and fortieth day; and after that time the muscular coördinations necessary for such an achievement develop rapidly; but in many cases sitting does not become common until about the sixth month. The ability to walk matures between the twelfth and the eighteenth months. Many other motor capacities of this kind are being studied in the laboratory and they prepare the way, as it were, for a serious study of the rate of development of more complex motor accomplishments in individuals and, by analogy, for an account of the rate of development of behavior patterns at large.

Language Habits.—As we have seen, the most important of all the habit problems is the problem of language. Behaviorism has made the most suggestive attempts to discover how it is that of all the movements which the organism makes, those conditioned by the vocal cords become the most significant. Birth, of course, gives the infant a vocal apparatus, a muscular and tendinous structure specific in form but fundamentally like any other response mechanism. Early in life the vocal habits begin to appear. Out of the babblings of infancy certain vocal sounds get established just as successful movements are established elsewhere in the body. The process of transfer from vocal habits to language habits is one of conditioning similar, perhaps, to the conditioning discovered among the emotions. The process has been described by Watson as follows:

"We will suppose that for some reason or other a child's toys are laid away and covered up. What does he do in such a situation? Essentially what the animal does when it is hungry. The child begins general restless movements among which are movements of the language structures as shown by its making 'aimless' vocal sounds. His throat formation at that stage of growth is of such a character that a particular sound is uttered frequently (let us say 'tata' for illustrative purposes). He begins to utter this sound as he roams about. The attendant, knowing the child's range of toys and the frequency with which he plays with a certain one, predicts that an old rag doll is sought. She finds it, hands it to him and says, 'Here's your tata.' Repeat this process long enough and 'tata' will be always used for rag doll and will always be spoken whenever the doll is sought. This process is, of course, repeated again and again in the course of a day. The word gets tied up with the act of seeking the doll. In this way baby words grow up as the first genuine form of true language organization.

"A stimulus to which a child often responds by opening and closing and putting objects into it is the box in which his toys are kept. The nurse, observing that the child reacts with his hands and fingers to the box, begins at a suitable age to say 'box' when the child is handed the box, 'open box' when the child opens it, and 'close box' when he closes it and 'put blocks in box' when that act is executed. This is repeated over and over again until the conditioned reflexes are thoroughly established. In the course of time the box in front of him, which originally called out only bodily habits, now begins to call out word habits. He says 'box' when it is handed to him, 'open box' when he opens it. The sight of the box now becomes a stimulus capable of releasing either the bodily acts or the word acts, or both. A series of functional connections is established between vision and throat and laryngeal muscles, which exists alongside of the already earlier established connections which run from the same receptor to the arm and leg muscles. When the box is presented now which act will take place? Manual action or laryngeal action? It is at this point that the influence of the environment upon the shaping and forcing of the language habits comes clearly to the front. There comes an occasion when the box can be seen but not reached. Action in the hand is blocked. He speaks 'box' and may speak it persistently all over the house. The attendant, hearing the word box, hastens to put it in his hands. In view of the fact that this situation is repeated day in and day out, not only with respect to this object but to hundreds of others, the child learns that the uttered word is a sufficient stimulus to cause the attendant to hand him the objects he names without actually having to execute bodily movements with respect to them. There has been a substitution of the language habit for a bodily habit—now by a word he can cause objects to move—his grunt or growl or infant toy word is law." [1]

Along toward the end of the second year the child makes what Stern calls one of the most important discoveries of his life, viz., the fact that everything has a name. To his everlasting questions, "What is that?" comes the answer, "That is——." Thus words or vocal reactions come to stand for or represent objects and events. Even the first stages in the development of symbolical language spring from this simple substitution. This is illustrated by the child that could not tell how many fingers the father had because it could count only the fingers on its own hand. Counting and "fiveness" did not belong to anything but its own fingers.

The use of words abstractly is a slow but extraordinary achievement. There is no object or event that is "five." "Fiveness" belongs to fingers in a sense wholly different from the way in which "Daddy" belongs to the object that walks around the room, brings home presents, and the like. As the illustration given above shows, even after one object acquires the additional designation of five this "fiveness" may not be carried over to any other object. But gradually the linguistic activity of the child becomes more and more symbolical and abstract, and by the time it is four or five years of age most of its reactions are verbal or involve verbal components. Preliminary experimental studies and an actual counting of the number of words show that a one-year-old infant may use on the average about ten specific words. At the end of the second year the number of words averages about five hundred, although some individuals have presented as many as a thousand words at this age. With each successive year the number of words increases so that a six-year-old child may have a vocabulary of from three to six thousand words. Over half of the total number of words used by a child are nouns. This per cent decreases as the child grows older; but the number of verbs and adjectives increases with respect to the total number of words used. The linguistic activity of a child during a single day is tremendous. Although a two-year-old possesses a vocabulary of about five hundred words it has been determined that these words may be used five or six thousand times a day. By the time the child is three or three and a half years old its common words are used from twelve to fifteen thousand times a day.

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[1] Watson, J. B., *Psychology from the Standpoint of the Behaviorist*, 1919, pp. 319–321.

The Development of Drawing.—It has been said that drawing, more than any other activity of childhood, reveals the inner mental life of the child, that an accurate history of a child's efforts to draw can be made a reliable objective index of the rate of development of its mental life and, in particular, of its memory talents. On this account, children's drawings have attracted a great many experimenters. Thousands of drawings have been collected and studied with great care, first with an eye to age and sex differences among the finished products, and secondly with an eye to the actual process of drawing itself.

Just as language is preceded by a stage in which the child plays by means of its vocal cords, so drawing is preceded by crude scribbling and penciling which is brought about, in part, by aimless playful handling of any object that will make a mark and, in part, through imitation of the movements of other persons as they draw or write. The child imitates the movement, the performance, not the thing accomplished. The child of this age probably enjoys some memory images, but there is no evidence to suggest that its scribblings are in any way related to these memory images. They begin, according to one investigator, with movements of the whole arm, but as the child approaches the stage of genuine drawing these movements are refined until only the hand and the fingers are used.

The crude, impulsive, aimless markings of the two-year-old change, at length, into more definite pencilings which appear to be of interest to the child for their own sake. Different drawings are given different names in contrast to the preceding period where the same markings may excite many different words. Furthermore, the pencilings come to resemble objects, not objects that the child sees, but objects that the child remembers. The drawings come to represent something in the mental life of the child, and thereby they attain value as signs of or reports of the growing inner life of the child. Not for some years does the child attempt voluntarily to draw objects which are immediately given in perception. Finally, however, as the range of his own perceptual knowledge and the accuracy of his memorial life is increased, he begins to find discrepancies between his drawings and actual objects, and it is thought that this discovery leads to a state of self-consciousness in which budding artistic talent may go into decadence.

Children will attempt to draw almost any object. The wind, the soul, breath, God, and similar impossible objects are attempted as readily as more real physical objects. An enumeration of the predominant motives in children's drawings indicates that younger children have decided preferences for human and for certain animal forms, then come houses, locomotives, plants and flowers, and other still-life objects, and finally conventional designs and ornaments. Nearly three-fourths of the spontaneous drawings of six-year-olds either are of or contain the human figure. After the rebirth of artistic ability in the fourteenth to fifteenth years the above order of preference for objects is just reversed.

Development of Memory.—We may consider the development of memory independently of learning, subject to what was said on pp. 21ff. concerning memory and learning problems.

The memory problem is indicated by Koffka in the following words: "If one brings an infant into a strange room before the completion of the first half-year, its behavior alters noticeably. The infant looks around the room with a wide-eyed 'astonishment,' which disappears as soon as the child is returned to its usual surroundings. The effect of the memory of its usual surroundings is indicated by an impression of strangeness, but the basis for this impression must already have existed, because its memory would have been the same had it never been taken into a strange room. . . . Within the first six months of a child's life one can also observe signs of smiling when the infant sees its mother or some other familiar person, and, on the other hand, signs of avoidance and displeasure when the infant is brought in contact with strangers." [1]

But modifications of behavior have been observed earlier than the sixth month. Gesell has reported a case in which a newborn infant cried when picked up, but within two weeks it had learned to cease crying when picked up and to begin crying when laid down. Although it is not probable that conditioning of this type occurs very often in the first few days of babyhood there is every reason to believe that the process begins rather early and increases enormously in importance after the infant is six months old.

The following illustrations will show how memory and learning are studied in young children. Very early, that is, before language develops, one must wait until the child has laid away a plaything and then, seizing the opportunity, ask the child where the plaything is. By waiting for five, ten, fifteen or more minutes one can carry through a very pretty experiment upon the child's ability to recall and recover the object named. Another method which is dependent upon language is known as the "Aussage" method. A picture is shown to the child and the child asked to give, either at once or after an interval, a description of the picture. A variation of the method is to take away from the child an object that has been in its environment for a considerable period of time (say a picture upon the wall) and note the child's reactions upon the discovery or list the number of items which the child is able to describe as belonging to the picture.

In one experiment of the first type mentioned above a three-year-old looked at a picture for two minutes and was then able to report thirty-five items of which five were wrong. Three days later without having seen the picture in the meantime this same child was able to report thirty-seven items of which number eight were wrong.

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[1] Koffka, K., *The Growth of the Mind*, 1924, pp. 241–242.

Physiological Memory.—Psychologists commonly distinguish between physiological memory and memory which makes use of what are called "free images." It is alleged that physiological memory modifies the behavior of the child for perhaps the first two years (and also most of the higher animals up to the ape) and that at approximately the second year the child begins to remember objects and events in the same way that adults remember them, *i.e.*, with the aid of memory images. In physiological memory there is only a functionally disposed nervous system; in memory proper the revived experience makes a definite reference to the past. We do not know as yet (see p. 24) whether *memory* and *learning* are two different talents; but in any case the memory talents increase in measure very rapidly after the second year and by the third year the memory impressions are being made so firmly and are so closely integrated the one with the other that they persist over into later adulthood. It is not often that adults are able to recall childhood experiences that antedate their third year. It is said that the memory talents increase until late in adolescence when the individual will have acquired his maturity so far as this phase of intellectual talent is concerned. It is to be hoped that we shall sometime be able to draw a curve showing these rates of increase in talent.

One phase of childhood memory has recently received a great amount of attention. Jaensch and some of his students have shown that many children have a remarkable ability to reproduce with full perceptual clearness some picture which they have just viewed. This imagery was called *eidetic* in order to distinguish it from ordinary memory images and from what are called memory "afterimages." These vivid recollections of objects seen and heard can be described by children with the same fidelity with which they describe the original perceptual materials. These studies have opened up a new group of problems in psychology, for they bear upon the relation between perceptions and their subsequent recall, the confusion in the minds of children between what they have seen and what they have imagined, the possibility of preserving this visualizing tendency and putting it to use later in the educational program.

Imagination or Prevision

Foresight.—The development of imagination still lies in obscurity, for the facts are so often confused with the child's use of his memories and with fantasies (as in fairy stories, etc.) that we cannot say when the child actually begins to previse the future. The reader is warned again that "previse" is not used here in the sense of divination. It is used for that specific talent by which an animal may extend the temporal boundaries of its environment to include what is yet to happen just as memory includes that which has already happened. To remember that it rained on the last cloudy day is one thing; to take an umbrella today because it is cloudy is another, and it is this second type of behavior which we call previsory.

When a five-months'-old child puts out its lips as the spoon is brought into sight we have not only a mode of reaction which is learned, but a mode of reaction which dips into the future. Many, if not all, learned reactions and all memorial materials may be used in this way. But as time goes on the use becomes more and more apt and more and more unique. To acquire foresight means to acquire a better regard for that which is to come.

As has been intimated, foresight may not be a distinct phase of intellectual talent. It may be either the temporal extension of the environment which learning and remembering afford or it may be a type of problem-solving. Let us turn to this mode of behavior.

Problem-Solving

The study of thinking occupies, as we have found, a curious place in psychology for the whole topic has been so loaded down with logic and with theory of knowledge that it has been almost impossible to tell where logic ends and psychology begins. This is particularly true in child study. There are altogether too few experiments of the problem type such as we present to animals and too many of the type which are alleged to concern judgment, the formation of concepts, the development of abstractions, the arrangement of categories, and the like.

One of the commoner ways of administering experiments in this field is to place before a child two collections of objects which are alike in some respects and unlike in others and ask the child to pick out the objects in the two groups which seem alike. Suppose, for example, we lay before a child three red triangles and three green circles. Now we present an object which resembles the one group in color and the other in form (red circle) and ask the child to pick out from the objects before him one that looks exactly like the one held in the experimenter's hand. If the same type of selection is made from trial to trial the experimenter may assume that the child is using the same principle of selection in each attempt. That is, it abstracts either color or form and makes it the determining factor in its selections. In these experiments color was the determining factor and the experiment was successful with children as young as two years, nine months. Other experiments have shown that color is not always the determining factor but the method has been successful in all other ways.

Another favorite way of handling problems in this field makes use of numbers. A child is asked to select from a group of identical objects, two, or three, or four; or of two groups containing two and three objects, respectively, the experimenter may ask, "Is this two or that?" Again, one may fill a chart with groups of dots and ask the child to pick out all the groups containing four dots. The first task mentioned above is easiest for small children, but two-year-olds, at least, cannot handle numbers above five. It is only five and six-year-old children that can find and name groups of dots containing five members.

From several studies of this kind it has been concluded that a use of the number 2 is ordinarily gained by three-year-olds, the use of number 3 by four-year-olds, and the use of 4 by five-year-olds.

A large part of our knowledge about problem-solving in children derives from reports made by parents and relatives on questions which they have put to their children. This material is informing but the whole problem needs more careful formulation and cleansing. The psychological problem does not have to do with the way in which children handle the syllogism but the way in which they learn to overcome difficulties. It would be a wholesome thing for this phase of research if someone could devise a group of problems at child level instead of at adult level and then find out how the child solves these problems when it uses its own devices. This program of research is actually under way and the results ought to be illuminating not only for child psychology but for genetic psychology as well.

The Development of Attention

Factors Governing Selection.—William James described the world of the infant as "a great blooming, buzzing confusion." It was implied that intellectual growth meant the ordering of this confusion, and order is aided no doubt by the fact that some objects become successively prepotent over others. The gestalt-psychology describes the same facts in a little different way. "We find the newborn child capable of movement whenever external stimuli come in contact with his senses, that is, whenever the equilibrium of his condition is disturbed. For instance, a bright object appears in the field of vision and the eyes move; a contact is made with a certain place on the hand and the fingers close, etc. In every case a state of rest is interrupted; into the already existing world wherein the child was at rest a new factor has been introduced which disturbs his quiescence. If we wish to reconstruct the phenomenal counterpart of this objective behavior we must consider the child's state as a *whole.* Consequently, we ought not to say that the child sees a luminous point, but rather that the child sees a *luminous point upon an indifferent background,* or, in the case of touch, that pressure is felt upon the hand, otherwise untouched. Generally stated, *from an unlimited and ill-defined background there has arisen a limited and somewhat definite phenomenon, a quality.*" That is, in the effective environment of the child, some objects acquire prepotency over the rest and they acquire it, as we have learned, either because of factors intrinsic to the environment (energy of stimulus, etc.), or because of factors intrinsic to the organism (innate or acquired preferences, attitudes, and dispositions).

Of the facts, there can be no doubt. Dismemberment of the environment, ordering of the members, the erection of figures on grounds, successions of events and objects which have acquired for the moment a prepotency, attention, however we may describe it, the process does proceed. But how fast it proceeds we do not know. We assume that primary attention appears first. That is, attention to or the selection of objects during the first few months of life is more or less automatic depending upon the intensity of the stimulus and the intensity of the factors we call interest. How long this condition persists is uncertain. Educational procedures are based upon the assumption that it endures well into the upper grades. But in the meantime selection that is based upon acquired interests, based upon learned habits of attending, becomes more and more significant in the life of the child. In well-trained adulthood, habitualized attention is one of man's most valued acquisitions.

Emotionally Toned Reactions

Native Emotional Patterns.—It has been discovered that at least three emotional patterns are fundamental in the behavior repertory of the infant. Others may be found, but the discovery of these three has set the problems and furnished a mightily suggestive method for all further studies on emotion and instinct.

The three original or native emotional patterns which have been distinguished thus far are fear, rage, and love.[1] The principal situations which arouse the fear attitude and responses (catching the breath, clutching, crying, etc.) are (*a*) the sudden removal of all means of support, (*b*) loud sounds, and (*c*) a sudden shake or pull. These situations arouse the fear attitude and the fear responses at birth. They are the situations which invite the organism to dispose of its energies in more than normal amounts to meet the new situation.

The original situation which produces the rage attitude and the rage responses is a hampering of the infant's movements. The responses are crying or screaming, a stiffening of the body, random movements of the limbs, and holding the breath. Here, too, we see how the organism is hereditarily disposed to adapt its energies to certain types of stimuli.

Love (the word is used in a very wide, Freudian sense) is excited originally by stroking or manipulating various portions of the body, by tickling, shaking, gently rocking, patting, and the like. The responses are smiling, gurgling, and cooing. Ordinarily, crying will cease under such stimulation.

Conditioned and Unconditioned Responses.—One of the processes by means of which original behavior is *re-created* into new patterns has already been described (p. 201). The mechanics of the process as applied to humans may be illustrated in the following manner:

> "If a subject sits with the palm of his hand upon a metal plate and his middle finger upon a metal bar and an electrical current is sent through the circuit thus completed by the hand, the finger will fly upward from the metal bar the moment the electric shock is given. This painful stimulus is thus the native or fundamental stimulus which calls out the defensive reflex of the finger. The sight of an apple or the sound of a bell will naturally not produce this upward jerk of the finger. On the other hand, if the bell is sounded or the colored object is shown the moment the electric current is completed through the hand, and this routine is repeated several times, the situation becomes

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[1] Watson, J. B., *Behaviorism*, 1925, Chaps. VII, VIII.

wholly different. The finger begins to jerk up reflexly now and then when the bell is rung or the colored object shown even if the electrical current is not sent through the hand. After a longer or shorter period of training the colored object will cause the jump of the finger just as inevitably as does the current. This we call a conditioned motor response and we have shown that these conditioned responses persist for long periods of time, in some cases possibly throughout the life of the individual. There is no 'reasoning' or 'association of ideas' involved, because we can produce conditioned reflexes in very low forms of animals. The same thing occurs in our glands. If one attaches a small apparatus to the parotid gland—one of the salivary glands in the cheek—in such a way that the saliva flows out drop by drop, it can be shown that the direct stimulus of the gland is *actual contact* with some edible or drinkable substance, for example, weak hydrochloric acid, vinegar, etc. The moment such an acid touches the tongue the gland begins to flow profusely. Ordinarily the sight of objects does not produce an increased flow of the glands, but if combined stimulations are given, the object being shown at the same time the acid is given, the sight of the object finally will produce an increased flow of the gland. This is of course what happens every time food or drink is brought to the mouth. Thus the youngster's mouth has every reason to 'water' when a stick of candy is held in front of him or our own when we are hungry and a toothsome morsel is held before our eyes. It is probable that all of our glands, even the so-called ductless ones such as the thyroid or the adrenals, become conditioned by means of such environmental factors throughout our life." [1]

This principle of conditioning a reflex has been applied to such complex forms of behavior as emotions and instincts. In infants, as we now know, the most adequate original stimulus to fear is a loud noise. Fear is induced by no other objects in spite of the common assumption that animals, furry objects, moving objects, and darkness instinctively arouse fear. The problem, then, requires the conditioning of the fear response. For this purpose there was presented simultaneously to an infant a white rat and a loud sound. The rat alone had previously been reached for; but the sound alone induced the normal fear reaction. The laboratory notes in this experiment illustrate the facts.

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[1] Watson, J. B., and R. R., "Studies in Infant Psychology," *Sci. Mo.*, 1921, Vol. 13, pp. 510–511.

"Eleven months, 3 days old. (1) White rat suddenly taken from the basket and presented to Albert. He began to reach for rat with left hand. Just as his hand touched the animal the bar was struck immediately behind his head. The infant jumped violently and fell forward, burying his face in the mattress. He did not cry, however.

"(2) Just as his right hand touched the rat the bar was again struck. Again the infant jumped violently, fell forward and began to whimper.

"In order not to disturb the child too seriously no further tests were given for one week.

"Eleven months, ten days old. (1) Rat presented suddenly without sound. There was steady fixation but no tendency at first to reach for it. The rat was then placed nearer, whereupon tentative reaching movements began with the right hand. When the rat nosed the infant's left hand the hand was immediately withdrawn. He started to reach for the head of the animal with the forefinger of his left hand but withdrew it suddenly before contact. It is thus seen that the two joint stimulations given last week were not without effect. He was tested with his blocks immediately afterwards to see if they shared in the process of conditioning. He began immediately to pick them up, dropping them and pounding them, etc. In the remainder of the tests the blocks were given frequently to quiet him and to test his general emotional state. They were always removed from sight when the process of conditioning was under way.

"(3) Combined stimulation with rat and sound. Startled, then fell over immediately to right side. No crying.

"(4) Combined stimulation. Fell to right side and rested on hands with head turned from rat. No crying.

"(5) Combined stimulation. Same reaction.

"(6) Rat suddenly presented *alone*. Puckered face, whimpered, and withdrew body sharply to left.

"(7) Combined stimulation. Fell over immediately to right side and began to whimper.

"(8) Combined stimulation. Started violently and cried, but did not fall over.

"(9) Rat alone. *The instant the rat was shown the baby began* *to cry. Almost instantly he turned sharply to the left, fell over, raised himself on all fours and began to crawl away so rapidly that he was caught with difficulty before he reached the edge of the table.*

"This was as convincing a case of a completely conditioned fear response as could have been theoretically pictured. It is not unlikely had the sound been of greater intensity and the child more delicately organized that one or two combined stimulations might have been sufficient to condition the emotion. We thus see how easily such conditioned fears may grow up in the home. A child that has gone to bed for years without a light with no fears may, through the loud slamming of doors or through a sudden clap of thunder, become conditioned to darkness. We can easily explain how it is that a sudden flash of lightning finds you all set and tense, oftentimes with the hands over the ears, before the clap of thunder, which is the true stimulus to such action, appears." [1]

Further trials brought forth the fact that after the infant had been conditioned to a white rat, it was afraid also of a rabbit, a dog, a fur coat, and cotton wool. Previous to the conditioning all of these objects were freely played with and handled.

Here, then, is a mechanism by means of which a relatively simple original response may be made to serve the interests of the organism in a large way. No one knows at present how far the process of conditioning may go. At any rate we may safely assume that original nature is soon weighted down with a load of conditioned stimuli and modified responses so as to conceal completely the original behavior itself.

THE DEVELOPMENT OF PERSONALITY

In marking the progress of the infant toward adulthood and, therefore, toward individuality it is frequently valuable to point out certain periods or stages in the acquisition of selfhood. That is to say, because of the continuous enrichment of mental life throughout childhood and youth, the child becomes increasingly able to sustain certain stable relations with the world and with other human individuals. Although these increasing social capacities and obligations are not sudden acquisitions, nevertheless, there is pedagogical value in pointing out periods of development and we shall, accordingly, describe the growth of selfhood in this manner. The process is rendered more unique in the child than among animals, for the social part of the environment (see Chapter IX) is of tremendous importance in fixing the personality of the child.

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[1] *Op. cit.*, pp. 511–512.

Periods in the Progress toward Adulthood.—One scheme of classification speaks of the following periods: [1]

1. Pre-social Period. 0–1.
2. Imitating and Socializing Period. 1–3.
3. Period of Individualization. 3–6.
4. Period of Competitive Socializations. 6–12.
5. Period of Adolescence. 12–25.

The first period, the pre-social period, we have already discussed under a paragraph treating of the talents of the infant at birth. It is obvious that during the first year the infant is neither social nor anti-social. It is, on the contrary, unsocial. It is probable that its own mental life has no organization and its habits with respect to all save a few objects are highly unstable.

The second period is not set off from the first by any unique intellectual acquisitions or by any sudden new behavior patterns; but it does represent a rapid building up of mental life upon the foundations we have described as having been laid in the body and in the nervous system. Up to this time the most of the child's experiences have been for the purpose of getting his bodily needs satisfied; but now the world and the objects in it become interesting for their own sake. His muscular coördinations ripen rapidly and he begins to manipulate objects about him. Soon he is able to walk to them and actively to move and push them. The perceptual life of the child increases with amazing rapidity and there begin to appear certain indices that he will soon use imaginal stuff in the acquisition of meanings and in the control of his conduct. His affective and emotional life becomes quite specific as it is reflected in his face, voice, and general behavior. It has been said that the child consciously imitates other persons about him during this period; and, although he certainly does do things identical to those done by an adult and often immediately after the example is set, it is by no means clear that imitation is taking place in the simple manner the statement suggests. We have already pointed out the fact that language is acquired early in this period and that a vocabulary accumulates at a fairly rapid rate. The items in this vocabulary are, however, quite specific in their meaning. That is to say, words are for some time tied closely to actual physical objects. Toward the end of the period the words begin to increase in meaning and are sometimes used without specific attachment to physical objects; they come to be used in making general references. Habits are easily and rapidly formed during this period. The nervous system is, presumably, as "plastic" as it will ever be and neural pathways are easily laid down. Toward the end of the period the child begins to recall and relate little stories of events that may have happened days or even weeks before.

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[1] See Kirkpatrick, E. A., *The Individual in the Making*, 1911, pp. 55–63.

Marston has shown that between the ages of one to three, a great many children learn those social attitudes or emotionally toned attitudes which we call introversion and extroversion.[1] One hundred children were studied as they adapted themselves socially to a stranger, complied with the request to perform a difficult task, adjusted themselves to a varied and novel environment, and asserted themselves when wishes and requests were denied. It was shown that long before the normal age of school entrance, children as young as two or three years had developed characteristic social attitudes toward such situations as we have named.

The third period, running from three to six, may be described in social terms as the period of individualization. Social influences are prominent, but the child begins to develop a larger longitudinal organization of his own behavior patterns and out of this organization and its organic background comes the realization of a self as distinct from other selves and from inanimate objects. The child becomes a more active and unified participant in the acquisition of knowledge, in manipulating objects, and in attending, in general, to his own pleasures and satisfactions. The rapid development of language coupled with a freedom of words from physical objects (words become symbols or substitutes) give the child a world of his own to deal with. Within this world of ideal objects he becomes a central figure. His self-assertion in it is carried over to his activity in the perceptual world. His imaginal world is full of odd objects and incidents and frequently he plays with this world in a manner that astonishes his adult observers. In it memories of actual objects are correlated with his dream pictures and with the products of his own imagination in such a manner that for months the child may live quite apart in a world of ideas. His dream objects may seem just as real as the objects of waking life. He has, apparently, no ability to set a memory problem for himself until well along toward the end of the period. Later in the period the process of abstracting perceptual and ideational stuff may have gone far enough to allow him to use words or phrases with a general meaning or, as we say, in abstract form. He learns to count and "twoness" or "threeness" may come to have a meaning apart from specific references to objects.

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[1] Marston, L. R., *The Emotions of Young Children*, 1925. (Univ. of Iowa studies in child welfare, No. 2.)

The fourth period, from six to twelve, Kirkpatrick calls the period of competitive socialization. During this period the child assumes still more self-direction with reference to his neighbors. He begins to play and competition becomes a keyword in understanding the development of perception, of memory, of reasoning ability, and of mental organization. His interest in his perceptual life is shown by his attempts to become a naturalist or a stamp collector or a mechanical engineer; his memory ability is surprising; his vocabulary grows amazingly; "abstract ideas" enter more specifically than ever into his life.

The fifth period, the period of adolescence, has probably had more study than all the other periods together. On the other hand, a relatively small part of the literature about adolescence is scientifically reliable. The period is marked, it will be recalled, by a great rejuvenation in the physical and mental life of the individual. Although the rapid growth of the body and the development of new organs may bring about a change in perceptual processes, the greatest changes appear in the affective life and in the development of the elaborative functions. The period is full of violent emotional experiences. Many of the sentiments are born during the period. Toward the end the child has become the man, the social adult.

Summary.—The amount of work that is now being done on the development of different intellectual traits and talents is simply prodigious. Psychology is almost in a position to draw curves of development for different traits where the abscissas mark the passing of time and the ordinates the increase in talent. As a matter of fact, segments of many of these curves have already been drawn and it is instructive to note that a large portion of them resemble the typical learning curve. We shall give two illustrations of the facts illustrated by these curves.

The aim of the ordinary association tests is to measure rates of association and distinguish between what are called "common responses" from those known as "individual responses." The number of common responses in a four-year-old is about forty per cent. At six, the number has risen to sixty-five per cent, by eleven to ninety per cent, but at fifteen the curve is still on about the same level.

An eight-year-old child can tap with its right hand at a rate of approximately 145 times per minute. The score of an eleven-year-old jumps to 168 times per minute, that of a thirteen-year-old to 180, that of a fifteen-year-old to 190, at which point the curve appears to level off showing that further notable increases in speed of tapping are not to be expected.

In addition to measures of specific aptitude like the foregoing, there is an increasing number of measures based upon alertness tests and intelligence tests. These are, of course, less satisfactory than the measures of specific aptitude, but many of them show unmistakably the trend of intellectual development. Most of the curves show tremendous positive acceleration of development in the early years and a negative acceleration as the child approaches adolescence. It is not yet clear what adolescence does to the rate of improvement in talent. It is commonly believed that some talents, at least, enjoy a second stage of positive acceleration, especially those talents which have to do with the attitudes and with the higher intellectual functions.

The Stanford Revision of the Binet-Simon Tests.—Mental testing proceeds upon the assumption that a mental level can be described after certain samples of the level are on hand. Intelligence testing may be likened to the task in geology of prospecting for oil, coal, gold, copper, or other natural products. It is not necessary to uncover the whole vein in order to show that the vein is present and that it is eight feet thick in one part and only five feet thick in another. In an analogous way, small samples of psychophysical capacity are secured and they are taken as representative of the general mental level.

Under the Stanford Revision of the original Binet-Simon tests, a three-year-old child ought to be able to point to the commoner parts of its body, name a few familiar objects, enumerate some of the items in a picture, tell its own sex, give its name and perhaps the name of the family, repeat six or seven syllables after they have been spoken by the experimenter, and repeat three digits.[1] A four-year-old child ought to be able to discriminate the length of two lines, discriminate geometrical forms such as a cross, a circle, a square, and a triangle, count four pennies in a row by pointing to each in turn, copy a square drawn in heavy black lines upon a card, repeat four digits after they have been spoken by the experimenter, repeat twelve or thirteen syllables, and show some comprehension by answering such questions as, "What must you do when you are sleepy?" "What ought you to do when you are cold?" A five-year-old child ought to discriminate between two equal-looking but actually different weights (3 and 15 grams), name the colors red, yellow, blue, and green, show some degree of æsthetic comprehension by choosing the better of two pictures, give a definition in terms of use of such words as chair, horse, fork, doll, pencil and table, take a cut rectangle and arrange the two pieces so that they are like an uncut model, execute three commands that have been given in a single sentence, and give its own age.

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[1] See Terman, L. M., *The Measurement of Intelligence*, 1916.

In the sixth year the child ought to be able to distinguish the right from the left hand, pick out defects in pictures which have an eye, a hand, or some other part missing, count by pointing to each, thirteen pennies, show a little higher order of comprehension by answering such questions as "What would you do if you should find that your house was on fire?" name four coins—a nickel, dime, quarter, and half dollar—repeat sixteen to eighteen syllables, and tell the differences between morning and afternoon. A seven-year-old ought to be able to count the fingers on one hand, describe in some detail the objects in a picture, repeat five digits, tie a bowknot, state from memory the difference between common objects (a fly and a butterfly, a stone and an egg), copy such a geometrical form as a diamond, name the days in the week, and repeat three digits reversed. An eight-year-old child ought to show some plan or purpose in pointing out to the experimenter how he would search a field (drawing lines on a paper) in search of a baseball he had lost. He ought also to count backwards from twenty to one, comprehend still more difficult questions than was the case for earlier years, point out the similarities between such objects as an apple and a peach or a ship and an automobile, give definitions (more than their mere use) of such words as balloon, tiger, football, and soldier, have a vocabulary (words that he can define) of about 3,600 words, name six coins, and write a short sentence from dictation.

The average vocabulary of individuals at different ages is shown in the following table:[1]

TABLE I

8 years	3,600
10 years	5,400
12 years	7,200
14 years	9,000
Average adult	11,700
Superior adult	13,500

The nine-year-old ought to be able to give in turn the day of the week, the month, the day of the month, and the year, he ought to arrange in a series five weights which resemble one another in appearance, make simple monetary changes as if purchasing articles at a store, incorporate three words into a single sentence, find a number of words to rhyme with a given stimulus word, name all of the months of the year, and count the value of five or six stamps laid side by side. At ten years of age the child ought to detect simple absurdities in sentences, draw designs from memory, read a short paragraph and then retell the substance of the paragraph, exhibit an increasing amount of comprehension, name approximately sixty words in three minutes, repeat six digits, repeat about twenty-two syllables, and put blocks correctly into a frame prepared for them (Healy form board).

As the child grows older he ought to be able, in succession, to define such abstract words as pity, revenge, charity, envy, and justice, straighten out sentences whose words have been jumbled or dissected, interpret fables, repeat five digits reversed, interpret a picture, point out the similarities between three different objects, show some signs of ability to formulate a rule or a principle, solve problems of conduct or of action, do simple arithmetical problems, tell the time by reversing the hands of the clock so that the minute hand becomes the hour hand and the hour hand the minute hand, repeat seven digits, point out differences in such abstract terms as laziness and idleness, or evolution and revolution, repeat six digits reversed, use a simple code, repeat twenty-eight syllables, point out some simple relations between physical objects, and solve simple puzzles as a test of ingenuity.

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[1] Modified from Rosanoff, A. J., *Manual of Psychiatry*, 1920, p. 511.

Conclusion.—Child psychology marks, probably, the most active of the current fields of research. A large part of this research is avowedly for the sake of education, both parental and formal; but a large part, too, is motivated by the desire to trace the origins of and mark the progress made in, all of the phases of intelligent behavior. It looked for a time as though child research was to be limited to the compilation of tests; but the test movement has merely whetted the appetites of men for facts that run deeper than those that can be got from intellectual "assays." It begins to look as though the department of research which began with Preyer's *Mind of the Child* would shortly become, not only a material portion of the whole science, but, taken in conjunction with animal psychology, a determinative factor in the whole outlook of the science.

CHAPTER VIII

THE INHERITANCE OF INTELLECTUAL TALENT

Introduction.—All that has been said in the last three chapters could almost equally as well have been said under one chapter heading, viz., Comparative Psychology. That is, one could take all forms of behavior in animals and play the game of comparing one animal with another, one child with another, and children with animals. Nothing need be said about development or evolution. One might make out a ledger, enter the intellectual liabilities and the assets of all living creatures, and then publish a Bradstreet's.

But the bookkeepers dream over their work. They look into the future and wonder where life is going. They wonder how the intellectual assets of the children may be increased.

The theory of evolution furnishes a partial answer to these reveries. It shows us, instead of a Bradstreet's, a flowing river, a dynamic onward-moving, upward-moving, striving nature. The fact seems indubitable. Life is *under way* and in many philosophies (not all) it is on the way upward. The stages we have roughly outlined. Creatures have become more and more intelligent. But we want to know why! What conditions make for progress and which for retrogression? Is it possible to do a little toward guaranteeing the future by knowing the forces that have made for betterment in the past?

There are plenty of theories as to the relation of natural selection to the intellectual progress of the race, the part which intellect itself may have played, and the part which a dynamic mental stuff may have played, but most of the energy of the biologist is expended upon the problem of finding an adequate mechanism of inheritance, that is, a mechanism or a physiological process that will explain not only the continuity of life but the onward and upward march of life. A final proof of the proposition that life has passed through a long series of developmental changes rests upon the discovery of a physiological process which will explain (*a*) how it comes about that life forever re-creates itself from one generation to another, and (*b*) how it has happened that changes have appeared in each succeeding generation which have enabled life to move forward, to "improve" itself. There could be no evolution if inheritance meant photography. Life would forever duplicate itself. This, we see, is the view of those who hold to creationism.

CAUSAL FACTORS IN EVOLUTION

Natural Selection.—Darwin's doctrine of natural selection assumed (i) an increase in any given animal population by geometric ratio, (ii) slight variations in the form or in the talents of individuals, (iii) lack of room and food for all the offspring of all species, (iv) a competition for food and for place, (v) an advantage which accrued to individuals fortunate enough to have come by useful variations in form or talent, and (vi) the heritability of the useful trait.

All of these assumptions may be said to hold true of intellectual talent as well as of bodily trait. It is obvious that the creature which made the most rapid progress in widening its effective environment or refining its powers of discriminating reactions would have a better chance for survival. The same line of argument holds for the other moments of intelligence. The problem-solving animal certainly had an advantage over the animal that could not get itself out of difficulties. Thus the evolution of intelligence was *explained.*

The great weakness of this doctrine was that it failed to explain the most important matter, viz., from whence come the variations of which some are so useful?

Mind in Evolution.—It has, in the past, been fashionable among philosophers and among some psychologists to make mind an effective agency in the progress of life. We have already found a hint of this procedure in that type of psychologizing called functionalism (see p. 113). The functionalist urged that mind was an agent that stepped into the process of adjustment at crucial moments, thereby favoring the process. Other modes of thinking, however, have gone far ahead of this in that mind has been translated into a "will to live" or into some other equally dynamic agency.

The doctrine of natural selection and theories of the efficacy of mind in evolution have not been convincing and, as was intimated above, biologists have turned away from the speculative issues and have begun to devote themselves more and more to a study of the actual mechanics of heredity with a view to discovering in these studies the causal agencies which have eluded speculation. We shall ask, first, what the problem of inheritance is, in so far as it touches intellectual talents and then we shall review a few of the facts of genetics that appear to have a bearing upon the problem.

The Problem of Mental Inheritance

The prejudices and convictions of men concerning the inheritance of intellectual talent have never been very clear. There was a time when many writers, influenced by a theological or religious bias, would not admit that intelligence followed the same laws of inheritance as does the body, would not even admit that intellectual talent follows any laws of inheritance. Intellectual talent was alleged to be a gift at the pleasure of Deity. On the other hand, there has always been a widespread belief in the transmission of talent. "The child, we maintain, inherits its father's bad temper just as it inherits its mother's good looks. We consider twice before we adopt the foundling, which may be of dull or vicious parentage. We shake our heads over the wayward son, remembering that his father 'sowed his wild oats,' and we observe 'like father like son,' or 'blood will tell.' We expect to find talent in the children of the gifted, thrift or dwarfed intellect or high purpose, according as these qualities are 'bred in the bone.' The folk tale of paupered prince or stolen princess who never, though reared as swineherd or scullion, loses regal bearing and courtly demeanor, the wide respect for royal blood, and the lay belief in the 'born criminal,' alike testify to the common and venerable persuasion that minds, and even morals, are subject to hereditary transmission." [1]

The phrase, "mental inheritance," when taken strictly, is, of course, meaningless. If this is not obvious to the reader now, it will be after we have stated some of the facts that are known about the mechanics of inheritance. The phrase, "inheritance of mental life," is also meaningless. We speak loosely of eye color being inherited; but what we really mean to say is that some factor or agency in the germ cells disposes the growing organism toward blue rather than toward brown eyes. It is only in this sense that we may speak of the inheritance of any form of intellectual talent. We inherit nervous systems and it is not unreasonable to suppose that they may have certain traits or talents just as digestive systems have them. We say, for example, that an instinct is an inherited behavior pattern. What we mean to say is that the nervous systems of all robins have preferred pathways leading to that mode of behavior we call nesting in the springtime.

It is doubtful whether such an anology can be carried very far but it is unreasonable to suppose that an organ so large and so important as the nervous system should not have its variable talents appear in variable measure in different individuals.

Along with the biologist, then, the psychologist may inquire about the conditions for the inheritance of intellectual talent, about the conditions under which intellectual talent may be improved, about the part which such life has played in the history of evolution.

Biometry.—Before we go to a study of the mechanisms of inheritance it will be enlightening to ask just how similar or just how different one animal may be with respect to another. It is an obvious fact that living creatures do have a certain measure of success in photographing themselves. Every normal human being, for example, has hands and feet, a nose, a mouth, two eyes, a limited range of stature, a certain limited range of hair color, and a certain degree of intellectual talent. In all of these possessions he is, on the average, a fairly close duplicate of his father or mother, and in general, a duplicate of all human beings.

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[1] Bentley, M., "Mental Inheritance," *Pop. Sci. Mo.*, 1909 (Nov.), p. 461.

It never happens, however, that the duplication is exact. Hair color, stature, eye color, and all phases or moments of intellectual talent fluctuate from individual to individual. These fluctuations have been made the object of study of a branch of science known as biometry. It is the task of this science to make a statistical record of similarities between father and son or daughter, mother and son or daughter, or, as a matter of fact, between all blood relations, to work out significant formulæ which will express the degree of similarity between members of the same family, and to compare these formulæ with those gained in a comparison of individuals who are selected at random, or without reference to kinship. As we shall see, the members of a family are apt to resemble one another in direct proportion to the intimacy of kinship; and what is true of human beings is true also of animals.

Correlation Ratios.—Biometry states its results in the form of correlation ratios, and since we shall have further occasion to make use of this type of mathematics we turn out of our main road for a moment to consider the significance of a correlation ratio. In an investigation of the relative mental rank of 2,500 pairs of fathers and sons it was shown that, in a considerable number of cases, a father taking high rank bore children also taking a high rank, while fathers taking a low rank often bore children of low rank. A certain number of these cases can be attributed to chance. With chance as a basis, that is, with chance set at zero, we may figure the relative number of times that high talent appears in both father and son over and above chance. In the case cited, the degree of correlation was found to be .31 where 1.00 would express exact correlation and 0 would express no correlation at all. That is, 1.00 would express a correlation as exact as that which you would expect to obtain between the diameters and the circumferences of a series of circles. For every change in either dimension there is an exactly correlative change in the other. It is possible also to speak of negative correlation. If, as diameters grew larger, circumferences grew smaller, the correlation between diameter and circumference would be expressed as − 1.00. A 0 correlation would represent, then, no demonstrable relationship between diameters and circumferences.

The Inheritance of Talent.—The following table suggests the extent to which insanity may be inherited if we are to trust statistical evidence:

TABLE II

Data on Inheritance of Insanity (Rosanoff and Orr)

Parents	*Matings*	*Neuropathic*	*Normal Children*	*Expected*
Both insane	17	54	10	All insane
Only one insane DR x RR	93	190	239	1:1
Only one insane DD x RR	14		45	All sane
Both normal (but tainted) DR x DR	62	107	215	1.3
Both normal (only one or neither tainted) DR x DD (?)	20		77	All sane

Of the ten normal children from parents both of whom were insane, eight had not passed the age of incidence, that is, the age at which insanity first begins to make its appearance.

Studies on intellectual superiority are equally illuminating. Sir Francis Galton was the pioneer in the field of biometry and he began his investigations with a study of eminent men and women in England. Galton first undertook to collect the names of all the eminent men in law, science, literature, politics, religion, and art. Almost without exception Galton was able to show that the eminent men he studied were more apt to have eminent relatives than were men of moderate caliber. In three hundred families which yielded nearly a thousand eminent men (four hundred and fifteen at least were illustrious), it was found that forty-eight per cent of eminent men were sons of eminent fathers, forty-one per cent were brothers, and thirty-one per cent were fathers. As the degree of kinship became less the chances of being eminent were greatly decreased. That is to say, the grandfathers, uncles, nephews, and grandsons of eminent men stand less chance of becoming eminent than do brothers, fathers, or sons, but they stand more chance than members of the family still further removed, and a very much greater chance than persons who do not belong to family trees in which superior individuals are found.

Mental Inheritance in Twins.—If intellectual talent is inherited in much the same manner as are bodily traits, twins ought to be as much alike mentally as they are physically; or conversely, siblings (ordinary brothers and sisters) ought to be as different from one another mentally as they are physically. In experiments upon twins there are many facts to be considered. If likenesses between twins are due to the fact that each one of the pair gets the same home treatment, the same food, the same books, and goes to the same schools, the twins should grow more and more alike as they get older, ordinary brothers and sisters (pairs whose ages are not more than four to five years apart) should grow more and more alike, and twins should show greater likenesses in mental capacities subject to training than they do in capacities not subject to training. "(1) The nearer the resemblance of young twins comes to equaling that of old, (2) the greater the superiority of twin resemblance to ordinary fraternal resemblance is, and (3) the nearer twin resemblance in relatively untrained capacities comes to equaling that in capacities at which home and school direct their attention, the more must the resemblances found be attributed to inborn traits." [1]

The facts show that the resemblance of twins in some of the intellectual talents is about twice that of ordinary siblings. The correlation between twins in an opposites test runs as high as .90 while in siblings it is as low as .30. A word test gives twins a correlation of .71 and siblings a correlation of .29. In tests including a word test, a misspelled word test, a test in addition and subtraction, and an opposites test the average coefficient of correlation for young twins (9–11) was found to be .83 and for old twins (12–14) .70. These figures might mean that twins get further apart in mental traits as they grow older, a result due, perhaps, to changes in inborn traits.

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[1] Thorndike, E. L., *Arch. of Phil., Psychol., and S. M.*, 1905, 1, No. 1, p. 2.

Studies of the same kind show that capacities little subject to training give about the same coefficients of correlation as do capacities much subject to training. In other words, twins are alike in mental as well as in physical characters and they owe their resemblances to hereditary factors in each case.

The Mechanics of Heredity

There can be no doubt in the face of these statistics that members of a family are more apt to be intellectually alike than persons selected at random. This is true not only of general ability but of certain specific abilities. It may be true of all. In other words, intellectual ability is heritable. We shall not understand all that this means until we have considered the physiological processes by which it is possible. We begin with the vehicle of inheritance, that is, with the part of the body that is particularly concerned in the process.[1]

The Vehicle of Inheritance.—Inheritance in the amœba is a simple matter. Every twenty-four hours or so the mother cell divides in half, and the two daughter cells take up their independent existence without more ado. Under the microscope we may see that the nucleus in the protoplasm which is the amœba divides into two parts. Shortly thereafter the protoplasm itself divides and in the course of a few minutes the new individuals identical in character with the parent go their independent ways. Here the vehicle and the process of inheritance are fairly obvious. The whole body of the creature is the vehicle, and the process, while not understood either in causes or in its entire course, is plainly visible.

In more complex organisms neither the process nor the vehicle are so easy to describe. An adequate mechanism might never have been discovered had it not been for remarkable progress in the science of cytology or the science of cell structure and development. The doctrine that all living organisms are made up of cells (or of cell products) was announced in 1839 by two Germans, Schleiden and Schwann. Although the details of their work were in some respects inadequate, the main facts have stood unchanged, and now it is not only known that the organism is made up of cells (there are some 2.65×10^{13} of them) but that it develops from a cell.

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[1] Read Newman, H. H., *Evolution, Genetics and Eugenics*, 1925.

All cells are composed of a viscous or jelly-like material called protoplasm. Their size and shape is very irregular, depending upon their function and their location with respect to other cells. All cells consist of at least two parts, a central protoplasmic body called the nucleus and surrounding protoplasmic tissue called cytoplasm. Six or eight other bodies are found in some cells; but for our purposes the most important of these is the centrosome, a small body residing near the nucleus. Within the nucleus is a substance that stains highly under preparation for the microscope and it is, therefore, called chromatin. The chromatin may appear in the form of granules called chromomeres. The chromatin is probably the most important part of the whole cell structure if we are regarding the structure from the point of view of cell division and development.

Cell Division.—The mechanism by which cells originate from other cells is somewhat as follows. At its beginning the centrosome is seen to divide into two parts and each part migrates toward opposite poles of the nucleus. In the meantime the chromatin material has been thickening and becoming more prominent and finally this material falls apart into segments called chromosomes. Then, curiously enough, the chromosomes begin to arrange themselves with respect to the two poles of the nucleus or with respect to the two parts of the centrosome now lying at the two poles of the nucleus. When the arrangement is complete, the chromosomes are seen to split lengthwise, one half migrating toward one pole of the nucleus and one half toward the other pole. As this migration continues, the cytoplasm itself, as well as the nucleus, begins to divide, and in a short time two new cells have appeared, each one being made up of cytoplasm, a nucleus, a centrosome, and a number of chromosomes. These two daughter cells are, then, similar in all respects to the mother cell, and at a proper time each of the daughter cells may divide again into other cell bodies. It is by some such mechanism as this that the body is built, and it is much in the same manner that a new organism is initiated; the process is one of nature's greatest achievements.

Cells are of two kinds, the germ cells and the somatic cells. The former are the cells of reproduction while the latter are the cells of bodily growth. The germ cells may be either male or female. Among higher organisms all reproduction takes place by the conjunction of a male and a female cell. Before conjunction, both the male and female elements go through a process called maturation in which each throws off one-half of its total number of chromosomes. Upon the union of these cells, the total number of chromosomes is brought back to its former level, for the male and female cell bodies unite to form a single cell which has the same number of chromosomes as each of the sex cells had before maturation. In the subsequent processes of cell division the chromosomes continue to divide so that every cell in the body has as many chromosomes as every other cell. This fact, together with a large number of other facts of cytology, has led modern biologists to the conclusion that the chromosomes are the bearers of hereditary traits. It is inferred from a very large number of facts that every chromosome is made up of genes or units each of which is the bearer of some unit physical characteristic or of a cluster of such characteristics.

The Continuity of the Germ Plasm.—Many of the laws that govern the division and subsequent reapportioning of the chromosomes or of the genes are coming to be well known, and it is possible that in a few years every detail of the mechanics of heredity will be perfectly familiar. There are already certain generalizations that are of value to the psychologist interested in "mental inheritance." The first of these is the principle of the continuity of the germ plasm. The body is a sort of home in which the germ plasm lives, and it has been proposed that the germ plasm is potentially "immortal." By repeated cell divisions both the male and female elements are constantly multiplying. Many eggs are, of course, never fertilized and are cast off, but with every fertilization the germ cells maintain their own integrity and continue to live a semidetached existence in the new home the body cells start building. The body cells run their life course to a certain point and then die. In other words, the germ cells are a perpetual reserve supply out of which temporary homes are being successively built. In a real physiological or biological sense life is immortal; for so long as reproduction continues the germ plasm will propagate itself. It follows that we are all part and parcel of the same germinal stuff. "Parent and offspring resemble each other not because the offspring are, in any sense, the product of the parent's body, but because both parent and offspring arise from a common substance, the germ plasm." In a very important biological sense, father and son are brothers.

The Inheritance of Acquired Characteristics.—This generalization, which is known as Weismannism (after Weismann, who reaffirmed an older doctrine in such a manner as to command attention), is of more significance than at first appears. It affirms, as we have stated, that the germ plasm is inviolable, that it is carried from generation to generation without sensible modification. This assertion leads us to the conclusion that somatic accomplishments acquired by the body during its life do not affect the germ plasm. For a number of years it was believed by followers of Lamarck that "acquired characteristics" could be inherited. His beliefs in the matter made a profound impression in biology and Darwin himself was led to accept them in a modified form. Weismann's doctrine, however, stood in direct opposition to that of Lamarck's, and when the question was put under searching experimental methods Weismannism predominated. Biologists are now generally agreed that modifications in or acquisitions of the somaplasm do not permanently affect the germ plasm. The problem is still, however, a matter of laboratory investigation.

The Inheritance Equation.—The turn of the evidence in this direction was disheartening to a good many advocates of careful training and moral rectitude, and a new question for argument arose, viz., the question of the relative value of heredity and environment in the process of perfecting intellectual talent. If changes in the body are not inherited what part does the environment play in the life of the individual? Are all men victims of their heredity? Reams of paper and scores of chapters in books have been wasted upon this argument. Heredity or environment, nature or nurture—which is the more important? Most of the obscurity in discussions on this topic arises from a failure to see that the organism is a *product* of its heredity and of its environment instead of a *sum*. That is to say, we may reduce the individual to a formula of the following kind:

$$I = \int [H\,(S + E)].$$

In words the formula would read: The individual (I) is a function of his heredity multiplied by his social and physical environment. The social environment (S) may be added to the physical environment (E); but this sum must be multiplied by and not added to physical heredity (H). If either significant term of the formula equals zero the formula is meaningless. When heredity and environment are compared it is necessary to state what particular heredity is to be compared with what particular environment. Owing to the complexity of the germ plasm and to other factors which we shall shortly describe, every individual is potentially more than he appears to be. It is conceivable that the environmental changes may bring conditions better adapted to the appearance of characteristics that would otherwise remain buried. The environment cannot, however, change in any fundamental respect the qualities of the germ plasm.

Unit Characters.—A second generalization we have already mentioned in general terms but we must now state it in detail. We refer to the concept of the "unit character." Here again we come upon a striking example of the place of analysis in science and of the fact that the product of analysis need not be an atom or an electron or a cell, or anything that can be put under the microscope or placed upon a pair of balances. The "unit character" concept means that every individual is a collection or bundle of mental and physical characteristics and that each of these is borne by a unit, a "gene" or a "factor" in the chromosomes. A unit character is any characteristic of an animal, such as skin color, eye color, or facet number, that can be transmitted from generation to generation without losing its specific character or without suffering a qualitative change in the process. The genes, the physical representatives in the germ plasm of unit characters, are arranged, apparently, in a definite series with respect to one another and, as we shall see, the laws governing their division and redivision during the process of cell development are being rapidly discovered. A few samples of the unit characters of animals that are studied in the biological laboratory are: color of hair, color of eyes, length of hair, roughness of hair, characteristic distribution of pigments, length of horns, character of hoofs, and size of various organs and appendages. It is not at all impossible that the biologist will be able, ultimately, to make a list of all of the unit characters constituting a given organism.

Mendel's Law.—A third generalization of the facts of biology has come to be known as Mendel's Law. In 1865 and 1866, Gregor Mendel reported in an obscure journal the results of several years' work on the breeding of ordinary garden peas. From crosses between different varieties he derived the simple law of heredity which has come to bear his name. His work was neglected, however, until 1900, when three investigators, working independently, rediscovered the Mendelian principle, and from that time to the present Mendelian ratios have become the foundation of all genetics. As a result of Mendel's experiments the biologist speaks of two kinds of unit characters, the dominants and the recessives. The distinction between the two is based upon a difference in their behavior when crossed with one another. A dominant is a unit character which always appears at the expense of the recessive. In other words, a recessive unit character is one that may be transmitted from generation to generation without actually appearing in the new organism. It is covered up, so to speak, by some dominant. Under proper crossing, however, the recessive may be made to reappear. Mendel's generalization may be stated in the following words: The ratio of the appearance of dominants to recessives in the second filial generation is as three to one. This ratio means that as a dominant is bred to a recessive, three out of every four of the offspring will appear with the dominant characteristic. One of the offspring is a pure dominant, two of them only appear dominant but will breed dominants and recessives again in the ratio of three to one, and one of them is a pure recessive. This ratio, or complications of it, probably underlies all physical inheritance.

The Principle of Linkage.—A fourth generalization of the facts of heredity comes out of more recent experiments. Sex-linked inheritance has now become one of the common facts of genetics. The phrase means that certain characteristics are always tied in such a way to sex that the new individual very rarely, if ever, inherits the characters belonging to the opposite sex. An illustration may be taken from the fruit fly Drosophila. These flies are normally red-eyed; but occasionally a white eye appears. If a white-eyed male is mated with a red-eyed female the first generation are all red-eyed. In the next generation, however, there are three reds to one white; but the sexes do not share equally the two colors. In the second generation the females are all red-eyed, while half of the males are red-eyed and half white-eyed. In the same manner plumage characteristics may be linked to sex in birds. Sex-linkage is a special case of a general principle of linkage, for it seems that many unit characters are always bound up with others in the process of transmission from parent to offspring. That is, traits and talents appear often to come in clusters or groups.

Physical and "Mental Inheritance."—A small sample of the pertinent biological facts are now before us. On the one hand, we see a definite cell mechanism by which physical inheritance is possible. This mechanism is so well known that, at the present time, the biologist is able, in many cases, to predict with absolute reliability the outcome of any particular animal mating. On the other hand, we have a description, at least among the lower animals, of what it is that can be inherited. The biologist could make but little progress in genetics if he were not able to analyze or to break down into units the complex structures and functions which organisms bring to him for examination. As a result of his studies, the biologist claims to have found a large number of bodily characteristics which are unitary in the sense that each may be passed on from generation to generation without sensible modification. The organism is said to be the sum of these unit characters.

Now what is the meaning of these facts for psychology? Nowhere have we found any evidence for or suggestion of "soul" chromosomes, "mental" genes, or any other vehicle which, in and of itself, could bear a unitary intellectual talent. But neither have we discovered that good or poor digestion is heritable. Stomachs are inherited, and dispositions toward acidity or alkalinity may reside in the stomach walls and in other parts of the digestive tract. Likewise nervous systems are inherited, and the fact that the young of all animals are born with certain unlearned tendencies means that our nervous systems may be given to us with other tendencies toward preferred behavior patterns, preferred types of intellectual function, preferred types of emotional pattern, just as our eyes and hair have preferred colors and structures. The search for "intellectual" genes is, then, somewhat absurd. This we must remember as we now proceed to consider in more detail the problems of "mental inheritance." When we speak of "mental inheritance" we always bear in mind the fact that it is easier to speak of the intellectual talents themselves than of the unknown structural and functional properties of the nervous system which make such talents possible.

" Unit Mental Characters."—The first task of the geneticist in psychology is obvious. He must discover what mental talents are heritable. That is to say, what "unit mental characters" can be transmitted from individual to individual without losing their individuality. The psychologist's first attack on this problem has been by way of differential psychology, a topic we have yet to discuss but which we can anticipate enough to satisfy our present need (see p. 337). Differential psychology is a psychology of individual differences, a psychology which seeks to set down the extent to which individuals differ from one another in intellectual talent. That wide differences do exist we shall have no trouble in proving in the chapter treating of differential psychology (Chapter XII). After having assured himself that the differences he has discovered between individuals are fundamental, or that they have been factored into elementary traits and simple functions, he can predicate of these traits and functions heritability and thus build up a genetics of the intellectual talents of the individual.

In the meantime, however, the psychologist has gathered together some of the more obvious differences between individuals and has traced the hereditary principles involved. Some of the dominant physical characteristics of the human being are dark skin and hair, dark eyes, some forms of cataract, night blindness, deformities of the bones in the hands and feet, diabetes, and Huntington's chorea. The recessives are, respectively, blonde or light skin, hair, and eyes, normal eye (opposed to cataract), normal hands and feet, normal kidneys, and a normal nervous system. Some forms of feeble-mindedness are recessive to normal mentality. All of these characters are Mendelian. A certain form of muscular atrophy, red-green color blindness, and night blindness are Mendelian and sex-linked. Red-green color blindness, for example, appears in the male but is transmitted only by the female. The secondary sex characteristics which make up the obvious differences between the male and the female may, also, be sex-linked. Many other characteristics are thought to be Mendelian but to what extent is as yet uncertain. Such talents as general mental ability, memory, temperament, musical ability, literary ability, artistic ability, mathematical ability, mechanical ability, congenital deafness, cretinism, some forms of epilepsy and insanity, and longevity have been alleged to be inherited as unit characters, but it is doubtful whether a science of "mental inheritance" can be built upon characteristics so complex as are many of these abilities. They must be reduced to simpler talents.

From the information that is at hand, it seems plausible that mind is inherited according to the same principles that underlie physical inheritance. It cannot be proved at the present time that all mental inheritance is Mendelian; but the very general appearance of Mendelian inheritance among plants and animals and the remarkable success that has attended the explanation of genetic relations in terms of Mendelianism creates a presumption that mind must be inherited according to the laws that hold so widely throughout the animal kingdom. It is even possible that sex differences in mental organization and performance may be related to sex-linked inheritance and that many of the complex mental functions fall together in individuals through the general principle of linkage. The biological facts are at least suggestive and they invite to the field of mental inheritance the very best minds and the very best methods that the science can produce.

The Problems of Eugenics and Euthenics

The possibility of understanding and controlling the process of mental inheritance has become alluring to those individuals who are interested in the future of the race. The fact that so many families and nations have risen to intellectual achievement only to decline and pass away has prompted inquiry into the possibility of avoiding such an outcome in the future. It is becoming popular, therefore, to take seriously the science and art of *eugenics* or of right birth, and the science and art of *euthenics* or of right environment. It is quite natural that an acquaintance with the mechanisms of heredity, with the factors of organic evolution, with the laws governing the inheritance of mental and bodily traits and talents, should suggest the problem as to how we can control and even improve human minds and bodies.

The problem is simple enough among the lower animals. By relatively simple processes of mating, the geneticist can produce at will heavier cattle or pigs, or more generous milk producers or egg layers, or what not. That is to say, those factors which are economically or even æsthetically valuable can be watched for, appropriately selected and mated, and finally enjoyed.

Distinguished Families.—The problem is not so easy, however, in the case of human breeding. Who, indeed, shall sit in judgment over human intelligence, as we sit in judgment over the lower animals? We cannot be so optimistic in this generation as to suppose that any considerable proportion of the race is more interested in future generations than it is in its own immediate satisfaction or enjoyment. The hope of an adequate eugenics program lies in a thorough process of education. In the meantime, however, we can state the problem. Three or four illustrations will emphasize the need of adequate marriage laws. In 1900, 1,394 of the descendants of Jonathan Edwards, the eminent divine, had been traced. Of this number, "295 were college graduates; 12 presidents of our greatest colleges, besides many principals of other important educational institutions; 60 physicians, many of whom were eminent; 100 and more clergymen, missionaries, or theological professors; 75 were officers in the army and navy; 60 were prominent authors and writers, by whom 135 books of merit were written and published and 18 important periodicals edited; 33 American States and many foreign cities have profited by the beneficent influence of their eminent activity; 100 and more were lawyers, of whom one was our most eminent professor of law; 30 were judges; 80

held public office, of whom one was vice president of the United States; 3 were United States senators; several were governors, Members of Congress, framers of state constitutions, mayors of cities, and ministers to foreign courts; one was president of the Pacific Mail Steamship Company; 15 railroads, many banks, insurance companies, and large industrial enterprises have been indebted to their management. Almost if not every department of social progress and of public weal has felt the impulse of this healthy, long-lived family. It is not known that any one of them was ever convicted of crime." [1]

One of the most striking illustrations of the inheritance of ability is afforded by the descendants of Erasmus Darwin. "On the originality, general ability, and productiveness of Erasmus Darwin it is not necessary to comment. Robert Waring Darwin, his son, was a distinguished physician, and, like his father, a F. R. S. Another son, Charles, was a man of remarkable promise, and although he died at the age of 20, he gained the first gold medal of the Æsculapian Society for experimental research. Charles Robert Darwin, the author of the *Origin of Species*, and by common consent one of the world's greatest men of science, was the son of Robert W. Darwin. He married his cousin, Emma Wedgwood, a granddaughter of Josiah Wedgwood, F. R. S., the founder of the pottery works that produced the famous Wedgwood ware. Charles Darwin's four sons became men of note: Francis Darwin, F. R. S., a prominent English botanist; George Darwin, F. R. S., noted astronomer, and Professor of Astronomy at Cambridge; Horace Darwin, F. R. S., a prominent engineer; Mayor Leonard Darwin, author of works on political economy, president of the Eugenics Education Society, and president of the International Eugenics Congress. Finally must be mentioned Francis Galton, cousin of Charles Darwin, grandson of Erasmus Darwin, and an excellent illustration of the hereditary genius, the potency of which he did so much to demonstrate." [2]

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[1] Quoted by Walter, H. E., *Genetics*, pp. 228–229.

[2] Holmes, S. J., *The Trend of the Race*, 1921, p. 103.

Inferior Families.—Let us set against these records the depressing account of the Kallikak family. "During Revolutionary days, the first Martin Kallikak—the name is fictitious—who was descended from a long line of good English ancestry, took advantage of a feeble-minded girl. The result of their indulgence was a feeble-minded son who became the progenitor of 480 known descendants, of whom 143 were distinctly feeble-minded, while most of the others fell below mediocrity without a single instance of exceptional ability.

"After the Revolutionary War, Martin married a Quaker girl of good ancestry and settled down to live a respectable life after the traditions of his forefathers. From this legal union with a normal woman there have been 496 descendants. All of these except two have been of normal mentality and these two were not feeble-minded." A contrast of this kind cannot fail to be impressive.

The Jukes make up a similar distressing history. "Max Juke" was a shiftless, illiterate, and intemperate backwoodsman. Of 540 of this man's progeny, about one-third died in infancy, 310 were paupers who all together spent a total of 2,300 years in almshouses. Over half the female descendants were prostitutes, and 130 individuals were convicted criminals, including seven murderers. Only 20 of the family learned a trade and ten of these did so in prison. "It is estimated that up to 1877 this experiment in human breeding had cost the state of New York over a million and a quarter dollars, and the end is by no means in sight." [1]

The problem of eugenics and the final solution of the problem appear in the illustrations we have given. Eugenicists have, of course, many details to work out, but the main facts are clear. It is incredible to think that educated nations will set aside facts that bear so importantly upon national welfare and national life.

Euthenics.—The problem of euthenics is, as we have said, the control of the environment. We have already discovered that the germ plasm cannot be permanently altered by changes in the body plasm or by changes in the environment. We urged at the same time, however, that the germ plasm is complex. Many factors are carried in the chromosomes that do not appear in the individual. Some of these, being recessives, are effectually buried by dominant traits; but it is conceivable that many of them may wait for expression upon an adequate environment. This is the same as saying that at any given moment the psychophysical organism is more than it appears to be on the surface. Traits and capacities may be represented in the germ plasm; but the accidents of birth and of environment may have made it impossible for them to blossom. Euthenics is the art of treating the individual and the environment in such a manner that the best capacities will be trained and the worst left idle.

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[1] Walter, H. E., *op. cit.*, pp. 221ff.

Euthenics has also to consider the fact that capacities may be exercised in many different directions. The capacity to remember may be used for socially valuable ends or socially destructive ends depending upon the environment in which it is used. So with the other intellectual talents. If euthenics can control or change the environment so that the available traits of any given individual are turned to proper account it will perform a worth-while service to society.

The Social Heritage.—We have now considered some of the most general conclusions that may be drawn from the study of mental inheritance as it appears in the genetic laboratories. It is obvious that the problem is still in its earliest formulation and that the facts are only suggestive and not numerous enough to carry conviction. There is, however, another sort of inheritance that is peculiarly the property of the psychologist, an inheritance without the difficulties we have been considering. We inherit not only by way of a preorganized nervous system but by way of mental monuments or social traditions. Intellects have left behind them, as we shall see in another chapter, certain evidences of their activity, evidences that are not implanted in the nervous system but which are carried in terms of what we may call the "social heritage." The literatures, the sciences, the arts, in fact, the whole body of knowledge and the sum-total of mental achievement fall under the social heritages. Now these things are inherited just as truly as the other things we have been discussing. They may be had by any child in any civilized country for the asking. As regards natural endowment, we begin very much as our distant forbears began; but unlike them we stand under a burden of information and social obligation which for them did not exist. Physical heredity gives us a means of acquiring knowledge, a means of getting on with our fellows, a means of controlling adverse physical environment; but our social heritage gives us the knowledge we must acquire; it furnishes us with the record of past attempts to get along with each other and to get the better of hostile weather and arid soil. How to come into our social heritage, then, is the problem of education, a problem which we must work out for ourselves. Life, apparently, has solved the problem of physical inheritance; but to be surrounded from the day of our birth with the things that intellect has achieved, with customs, laws, fashions, language, literature, religion, and institutions, puts as great a problem in our own hands for solution. We begin our mental lives where our fathers left off, although our mental and bodily equipment is no greater than was theirs.

PART THREE

SOCIAL PSYCHOLOGY

CHAPTER IX

THE GENERAL PROBLEMS OF SOCIAL PSYCHOLOGY

Introduction.—We have defined psychology as the study of intelligence and intelligence as an appraisal which we make of the ability of another individual to create and to get on in an environment. But up to this point in our survey of the general problems of psychology we have assumed that we were dealing with a single individual and that this individual was being studied in relation to what we may call his *physical* environment. We have assumed that other living creatures were responded to in the same way that we respond to an automobile, to a storm, or to a star. But the presence of "fellows" in the environment of most animals, and especially in the environment of human beings, *makes a difference* in the whole story of animal behavior. The question we must now ask is: Does this difference bring any special problems to psychology or do we already have all the information that we need for an understanding of the way in which organisms settle their accounts with the *vital* part of their environments, *i.e.*, with their fellow creatures and with other living beings? [1]

Mutual Dependence.—This question may be answered easily enough for plants and for the very lowest animals. One amœba will pursue and attempt to swallow another much as it would pursue and attempt to swallow any other suitable bit of nourishment. It is hard for us to conceive of one amœba having any unique social value for another. Moreover, our observations do not show that, outside of its food value, one amœba or a group of amœbas depends in any unique way upon the presence of another amœba or of another group. We might, at the very most, assume that the chemical conditions for adequate living would depend upon the number of amœbas per unit volume of water; but beyond this such a phrase as "mutual dependence" can have little social significance to a form of life so primitive.

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[1] Read Young, K., *Source Book for Social Psychology*, 1927; Allport, F. H., *Social Psychology*, 1924.

Much higher in the scale of life, among ants, bees, and social wasps, however, we find an entirely different state of affairs. Here we see Nature's most magnificent experiment in communal living. The authors of the phrase "struggle for existence," forgot all about the social insects, whose habits and whose very bodily structures reflect everlasting mutual dependence (see p. 277).

Mutual dependence is incredibly more complicated among human beings than among social insects because a considerable part of the environment of the human being is made up of other human beings and of their spoken and written words and these must be considered reflectively, not instinctively. That human beings live in mutual dependence upon one another in the same instinctive and mechanical sense as do ants goes without saying; but there is in addition the whole matter of language, together with many another product that has come out of the history of human living and now forms an essential part of the environment of men.

Out of the above considerations we have derived the phrase "mutual dependence." The problems of social psychology center more or less directly upon this phrase. In most animal forms and prodigiously so in all the higher forms, a large share of behavior and attitude become inconceivable when taken apart from mutual dependence.

Of the many problems raised by this portentous fact we select the following for further consideration. (*a*) What are the biological, physical, and psychological conditions which favor mutual dependence? (*b*) What are the typical patterns or social groupings in which living creatures assemble themselves, assuming that mutual dependence actually produces social groupings of distinguishable type? (*c*) What new types of response or patterns of response are created by the social phases of the environment? (*d*) What is the history and what is the significance of these modes of response, and especially what is the history and the significance of language and religion? The first three questions will be considered in this chapter while the last will concern us in the two chapters which follow.

The Conditions of Mutual Dependence

There is little reason to suppose that living creatures have deliberately and intentionally sought to become mutually dependent upon one another. Even among human beings we cannot be sure that intelligence is often a predominating factor in the creation of social groups, for such organizations as the family, the crowd, a mob, a gang of boys, etc., are more irrational than rational. When we regard lower animals and primitive man we are led still more definitely to the conviction that other factors than intentional socialization are responsible for mutual dependence. We consider three such factors, viz., biological conditions, physical or geographic conditions, and social conditions.

Biological Factors Favoring Mutual Dependence.—There are three things about living creatures that favor mutual dependence, viz., common bodily structures and functions, prolonged infancy (especially among human beings), and common hereditary tendencies and instincts.

(*a*) *Common Structures and Functions.* The fact that we have common stature, similar features, similar color, similar vocal habits, helps, no doubt, to produce what has been called by a sociologist the "consciousness of kind." The shipwrecked and starving missionary who, upon hearing the words, "You ———, ———, ———!!!," is alleged to have cried out "Thank God, we are among Christians!" could offer, no doubt, vivid testimony upon "consciousness of kind." He had heard his own, even if not heavenly, language.

(*b*) *Prolonged Infancy.* So far as we know the two amœbas which take the place of one after cell division are immediately able to live as successfully as the mother cell. Infancy has no meaning in the life of an amœba. But as organisms have become more and more complex, infancy has come to be more and more significant. The human infant surpasses all other animals not only in its helplessness at birth but in the length of time during which it remains helpless. What does this mean? To relate the fact to two or three other facts will be instructive. Without thinking of cause or effect we may say that longer periods of infancy appear to be correlated with greater final plasticity of behavior, greater capacity to learn. The human infant, for example, surpasses other young in helplessness, but it surpasses them also in its promises for the future. Conversely, short periods of infancy are readily correlated with fixed, congealed types of behavior, and principally with instinct. Ants are remarkable for their instinctive intelligence and the newborn ant is practically as capable as the adult.

Prolonged infancy in the higher animals has another significance. Before birth the embryo is almost a parasite. Save in the mechanics of the process, parasitism continues for months after birth, for food must be brought to the infant and it must be warmed, washed, and clothed. These physical bonds of union are soon supplemented by social bonds of equal or greater strength. Whatever prospect of independence the human infant may have had at birth is lost in the habits of action and the type of environment which are provided for it by family life. Its whole nervous system is molded to favor collective living. The infant becomes a social or a mutually dependent individual before it can take steps to halt the process.

(*c*) *Hereditary Factors in Mutual Dependence.* By "hereditary factors in mutual dependence" we mean whatever can be meant by the term *instinct*. Among the lower animals the word seems to have a definable meaning. That is, there are behavior patterns which perfect themselves with a minimal amount of practice (see p. 199). The situation is different, however, with the human infant for learning or conditioning or modification of behavior patterns may begin even prior to birth. It is extraordinarily difficult, therefore, to know which moments of infant behavior are learned and which are unlearned. In spite of every attempt that has been made in recent years, however, to show that all of the traditional instincts are clusters of learned or conditioned reactions, a saving remnant of reaction preferences and unlearned neural dispositions still give content to the phrase "original nature." We now review some of these hereditary factors in behavior, first, some of those to be found among the lower animals and then some to be found among men.

(1) LOWER ANIMALS. The social insects, the ants, bees, and wasps are an eternal monument to the influence of hereditary factors in determining and conditioning social life. The ant that has just slipped out of its cocoon does not have to learn to fight an ant reeking with a strange colony odor. The limits of its devotion to a single ant society are already set within its own structure. Provision has been made, moreover, whereby all the needs of the community shall be taken care of by individuals uniquely made to play their part in the whole society. A queen, who is a fertile female, workers who are sterile females, fighters with large mandibles, and among the termites, even slaves, contribute to a well-rounded community. Within any single colony there are unique types of coöperation in the day's tasks, whether it is removing the larvæ to a safer place or dragging a heavy bit of food to the nest.

But even among the higher animals we find strong social impulses. To quote: "It is hardly an exaggeration to say that a chimpanzee kept in solitude is not a real chimpanzee at all. That certain special characteristic qualities of this species of animal appear only when they are in a group, is simply because the behavior of his comrades constitutes for each separate animal the only incentive which will bring about a variety of different behavior, and observation of many peculiarities of the chimpanzee will only be clearly *intelligible* when the behavior and counter-behavior of the individuals and the group are considered as a whole . . . ; the group connexion of chimpanzees is a very real force, of sometimes astonishing degree." [1]

(2) HUMAN BEINGS. Hereditary tendencies or impulses are also powerful sources of collective life among human beings. Although psychologists are not now in agreement as to what instincts and tendencies (if any at all!) really adhere to original human nature, we can give a few examples of the part which the more common alleged instincts play in determining collective life.

(i) Fear.—The instinct of fear, as an example, is said to draw men together. In our own lives we commonly believe and act as though a fearful situation faced while we are a member of a group is not nearly so fearful as it is when we are alone. We may venture the conjecture, then, that we seek one another out when we are confronted with a fearful situation. We do not know, of course, the precise conditions under which primitive man lived; but we may be sure that there were plenty of places and times where the ruthless forces of nature (wind, rain, storm, earthquake, and the like), and the attacks of wild animals and enemy tribes, must have aroused fear impulses and so have served in an indirect way to bring men together for comfort or for mutual self-protection.

(ii) Pugnacity.—Pugnacity is another of the alleged hereditary tendencies which may help us to understand, if not the origin at least the perpetuation, of social groups. If we use the term in a wide sense we may say that warfare is as old as life. On the basis of present conditions we may conjecture that disputes between primitive men related most frequently to the getting of wives, to the securing of food, and to the holding of a suitable habitation. The longing for family relations and the need for food and a dwelling place must have been of extreme significance to primitive peoples. Any act of another individual or of another group of individuals which threatened these needs was probably followed by fighting.

On the face of it, it looks as though fighting was an anti-social instinct. If the first business of primitive man was to get a wife and food, to ward off enemies, and to avenge personal insults, men should have been driven asunder rather than brought together. McDougall has stated the problem in the following words: "It might seem at first sight that this instinct, which leads men and society so often to enter blindly upon deadly contests that in many cases are destructive to both parties, could only be a survival from man's brutal ancestry, and that an early and a principal feature of social evolution would have been the eradication of this instinct from the human mind. But a little reflection will show us that its operation, far from being wholly injurious, has been one of the essential factors in the evolution of the higher forms of social organization, and, in fact, of the specifically social qualities of man, the high development of which is an essential condition of the higher social life."[1] McDougall finds the answer to this puzzle (*a*) in the fact that the primitive family was polygamous, consisting of a patriarch, wives, and children; (*b*) in the fact that customs and unwritten laws became more effective in determining the conduct of young males than their sexually aroused revolt against the patriarch, since the patriarch would exterminate the young men less capable of restraining themselves; and (*c*) in the fact that groups which had once learned to live together would perpetuate themselves by organizing themselves against other groups, since war demands mutual support.

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[1] Köhler, W., *The Mentality of Apes*, p. 293.

Much of this does not sound convincing but in any case ruthlessness gave way to prudence. Original intense hatreds, angers, sex-longings somehow became tempered and controlled before family life or any worthy gregal life could exist. Moreover, the old adage that "in numbers there is strength" may mean that in primitive life individual pugnacity had to give way to group or collective pugnacity. At any rate, in modern life war demands and calls for the highest order of collective achievement.

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[1] McDougall, W., *An Introduction to Social Psychology*, 1914 (11th ed.), pp. 281–282.

(iii) Food.—Another inherited tendency having value to social psychology is the food-getting impulse. Probably no other desire save that of sex drives the organism at a greater pace than the need for food. As we look upon our own pursuit of food we find numerous cases in which it can be obtained and preserved only by the coöperation of a group of individuals. We have no reason to suppose that, at a time when wild animals were numerous and when hunting implements were crude, individuals did not find it highly advantageous to hunt collectively. At least one writer (Read) has made the hunting pack the first form of human society.

(iv) Parental Tendencies.—The sex or mating instincts and related tendencies—to mother or to protect—are undoubtedly of fundamental importance to group life. The specific sex drive which forces the sexes together brings along with it obligations that are of definite social importance.

"The parental instinct is the foundation of the family, and, with few exceptions, all who have given serious attention to the question are agreed that the stability of the family is the prime condition of a healthy state of society and of the stability of every community."[1] "The parental instinct especially impels to actions that involve self-sacrifice, in the forms of suppression of the narrower egoistic tendencies and of heavy and unremitting toil on behalf of the offspring. Since these sacrifices and exertions on behalf of the children are a necessary condition of the continued existence and the flourishing of any society, whether small or large, we find that among all peoples, save the very lowest in the scale of culture, the institution of marriage and the duties of parenthood are surrounded by the most solemn social sanctions which are embodied in traditional public opinion and in custom, in formal laws, and in the rites and doctrines of religion. These sanctions are in the main the more solemnly and rigidly maintained by any society, the higher the degree of civilization attained by it and the freer and more nearly universal the play of the intellectual faculties among the members of that society." [1]

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[1] McDougall, W., *op. cit.*, p. 268.

There can be no doubt that the sex instincts underlie a large part of collective life. In the human species, at least, the claims of one's own offspring are first; and within the family circle we undoubtedly have the origin of most of our social preferences. The mothering and protecting tendencies make congregation necessary; and out of such physical proximity the first permanent social meanings may have become established.

(v) "Gregariousness."—Under a discussion of instincts we have, finally, to consider the alleged instinct of gregariousness, the tendency to be with one's fellows. Although there is considerable difference of opinion at the present time as to whether we can legitimately speak of such an instinct, many writers have distinguished a disposition, not only on the part of animals but on the part of man, to come together even when other reasons are lacking. The South African ox, for example, "displays no affection for his fellows, and hardly seems to notice their existence so long as he is among them; but if he becomes separated from the herd, he displays an extreme distress that will not let him rest until he succeeds in rejoining it, when he hastens to bury himself in the midst of it, seeking the closest possible contact with the bodies of his fellows." [2] In the human organism certain variations or interpretations of this instinct have resulted in the use of such phrases as "a longing for companionship," "a consciousness of kind," "the feeling of social relationship," and the satisfaction that comes from the assertion "I belong." "An instinct to play" has sometimes been alleged either as an additional instinct or as a form of the gregarious instinct. The common observation that children and animals prefer to play in groups has led to the assertion that all play activities spring from racial determining tendencies.

(vi) The Social Instincts.—Man is fearful, he can and will fight, he does search for a mate and become the head of a family, he will satisfy his hunger, and in all of this he is, at times, like the animals. But man is also kind and generous and thoughtful. He is a *survivor* in the struggle for existence, but he is also the good Samaritan.

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[1] McDougall, W., *op. cit.*, p. 269.

[2] Quoted from Galton (*Inquiries into Human Faculty*, p. 72) by McDougall, W., *Introduction to Social Psychology*, 1914 (8th ed.), p. 84.

This is not the place to settle the question as to where and how man learned to temper his animal nature by becoming unselfish. If these altruistic impulses are in any sense hereditary or instinctive (and many of the higher animals possess them along with man) then they contribute directly to communal living. If they are not hereditary, the very fact that man has the disposition to keep on learning them means that they have become a way of preserving social life. The fact that man does seem to foster the disposition to be unselfish is a fact of no small significance in social psychology.

Physical Conditions Favoring Mutual Human Dependence.—Among the physical conditions which favor collective life are geographic and climatic factors. "Man is a product of the earth's surface. This means not merely that he is a child of the earth, dust of her dust, but that the earth has mothered him, fed him, set him tasks, directed his thoughts, confronted him with difficulties that have strengthened his body and sharpened his wits, given him his problems of navigation or migration, and at the same time whispered hints for their solution. She has entered into his bone and tissue, into his mind and soul."[1] Numerous illustrations of the part that geographical factors play in determining collective life will occur to every reader. Cities are built on rivers and near lakes. Mountains separate one social group from another. The distribution of minerals, of rich soils, and of convenient highways are direct aids to the concentration of individuals and of groups.

Closely related to the geographic are the climatic conditions. Recent studies have made it appear that the chief product of social activity, civilization, varies more regularly with climate than had been supposed possible.[1] When maps of mean annual rainfall, prevailing temperate winds, and optimal temperature and humidity are made and compared with the distribution of peoples and the locus of noteworthy civilizations, the similarity cannot fail to become impressive. In other words, large numbers of people tend to become grouped where the geographic and climatic conditions are most favorable. In ancient history the Tigris, the Euphrates, and the Nile river valleys are good examples of the value of these physical factors in effecting the collection of individuals. Both the geographic and the climatic factors can be materially altered by the effort of the social group itself. The construction of railroads, for instance, may make possible the assembling of a large number of people at a place otherwise unsuited for collective enterprises. In like manner, the building of dams, the dredging of canals, and other feats of engineering skill may completely change the rigors of a climate or the course of transportation, and so create social groups by physical processes.

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[1] Semple, E. C., *Influence of Geographic Environment*, p. 1.

Social Products Which Favor Mutual Dependence.—Biological and physical factors have forced living beings into groups, group living has led, in turn, to the creation of certain products, and these products have become effective in conserving the social groups which created them. They have, moreover, become more effective in determining the character of these groups than the original biological and physical agencies. Languages, religions, laws, institutions, and customs have been precipitated out of group living, and now they react upon their creator in a multitude of ways which we must shortly consider. When we recall what this means in all of its psychological, social, and historical significance we may well stand appalled before the product of our own social activity.

The problem is complicated by the fact that these products of social living often stand in conflict with individual impulsions and desires, so that social products not only favor mutual dependence but threaten mutual dependence. Thus conflicts arise between the individual and society or, more accurately, between the hereditary tendencies and desires of the individual and the repressions which social living places upon the individual. These conflicts are among the most potent agencies for the production of mental instability, and for the destruction of social stability, and we shall consider them, therefore, in greater detail in their proper place.

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[1] Huntington, E., *Civilization and Climate*, 1915.

The "Social Mind" as a Condition of Mutual Dependence.—It is sometimes said that still a fourth factor in mutual dependence must be considered, viz., the "social mind," or the "group consciousness." This "social mind" is variously conceived, but most often as a sort of *super-mind* existing over and above the individual mind of each individual in the group. Men have set out from the observation that individuals conduct themselves when in groups in a way that they would not think of countenancing if they were alone. We are astonished at the moral depravity and the disregard of justice and law that characterize many social groups composed of sane and law-abiding individuals. Some sociologists and psychologists have taken cognizance of such facts as these and have concluded that there must be a *super-mind* to which the individual gives allegiance. They remark that the individual seems somehow to lose his individuality when he becomes identified with a group of like-minded persons. "When the student of behavior has learnt from the various departments of psychology . . . all that they can teach him of the structure, genesis, and modes of operation of the individual mind, a large field still awaits his exploration. If we put aside as unproven such speculations as that touched on at the end of the foregoing chapter"—(the view of James that the human mind can enter into an actual union or communion with the divine mind)—"and refuse to admit any modes of communication or influence between minds other than through the normal channels of sense-perception and bodily movement, we must, nevertheless, recognize the existence in a certain sense of over-individual minds or collective minds. We may fairly define a mind as an organized system of mental or purposive forces; and, in the sense so defined every highly organized human society may properly be said to possess a collective mind. For the collective actions which constitute the history of any such society are conditioned by an organization which can only be described in terms of mind, and which yet is not comprised within the mind of any individual; the society is rather constituted by the system of relations obtaining between the individual minds which are its units of composition. Under any given circumstances the actions of the society are, or may be, very different from the mere sum of the actions with which its several members would react to the situation in the absence of any system of relations which render them a society; or, in other words, the thinking and acting of each man, in so far as he thinks and acts as a member of a society, are very different from his thinking and acting as an isolated individual." [1]

This statement of the situation is by no means so extreme as are some wherein the "social mind" takes on properties and a reality quite equal to and even superior to the soul of traditional psychology. There are many arguments for and against the "mind" of a group. Against it may be set the fact that mental life is always conditioned by nervous systems; and there is no social brain. Objectors to the "social mind" argue that the phrase should stand for certain specific social facts and not for a new kind of mental life.

The "social mind" may be nothing more nor less than the mental life of the individual as it is changed or reorganized because of the presence of other individuals. In the same sense there is social behavior. Men act differently in the presence of other persons, not because of the existence of a super-form of behavior but because other people place limitations in the way of individual behavior. A pattern of behavior organized under the presence of other individuals is not composed of any *new* or unique kinds of behavior elements. The individual who exercises these new behavior patterns is not an essentially different kind of individual; he does not stand in any unique relation to objects, to other people, or to the behavior of another individual.

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[1] McDougall, W., *Psychology, the Study of Behavior*, 1922, pp. 229–230.

All that we can mean by the phrase "social mind" is that the organization of behavior patterns under social conditions is different from individual organization. Perceptions carry social references, and actions may be completed with the aid or against the resistance of other individuals. The organism behaves differently when making social "contacts." The "social person" is, for example, a suggestible person. That is to say, the individual is apt to act without reflection. The "social person" brings into existence, moreover, certain behavior patterns that imply other individuals. Patriotism, love, anger, sympathy, rivalry, and jealousy cannot be understood except as they reflect the existence of social groups. Facts of this kind belong properly to social psychology. We shall now consider them in greater detail.

Typical Social Groups

For political, sociological, and economic purposes groups may be divided according to size (couples, quartettes, choruses, juries, audiences, crowds, masses), according to race (English, Hebrew, Teutonic, Italian, Armenian, Chinese, etc.), according to age or sex (males, females, adolescents), according to culture or wealth (laboring men, capitalists, professional men, academic men, military men), according to politics (republicans, democrats, socialists), according to capacity (genius, mentally diseased, common people, etc.); but such classifications are of little use to psychology. True, the psychologist must attempt and has attempted to point out distinguishing intellectual and emotional peculiarities of the groups mentioned, and in particular the unique intellectual differences between men and women and between the races; but a description of the psychological characteristics of such groups tells nothing about the conditions under which groups are formed nor the psychological conditions which hold them together once they are formed.

Definition of Social Group.—A social group is a number of individuals moved to action or to thought, to emotion or to inspection by the same object or event, and who, at the same time, are aware of their membership in the group. The object may be given perceptually or imaginatively. The individuals composing the social group may be physically congregated together or seated in their separate dwellings. People may be congregated together and yet offer no special problem to social psychology if, in their action and thinking, there is no reference the one to the other. On the other hand, an isolated person may be a problem for social psychology if the objects about him or if his own behavior is replete with references to social matters.

Tentative Classification of Social Groups.—From the point of view of psychology groups may be described and classified in so far as they differ from one another in the predominance of any one of the several moments of intelligence which we have described. We may begin with mere physical congregations or collections as, for example, the group walking along the street of a town or city. The individuals are bent upon getting to business, to their shopping, or to their school on time. Up to a certain point they form merely an aggregation of individuals who happen to be together because streets are made for the purpose of bearing traffic. If the idea of "getting to the office" bears such references as "the streets are too crowded and I am being delayed," or "I wish people would watch where they are going," the group would begin to take on social importance.

The Crowd.—A *crowd* is a physically conjoined group made social by common perceptions. A group sees an accident, or the lynching of a culprit, or laughs at a stumble or a lost hat, or stops at some unique advertising display. These are perceptual events which assume an entirely different significance to individuals physically conjoined. Some of them are impossible for individuals alone. A fall upon a banana peeling is never so funny as when performed before a crowd. The cry of the street gangster: "Say, mister, do it again," is pregnant with the social significance of a misfortune that would otherwise be passed off in a less humorous setting. A crowd becomes a gathering or a conflux when the object which brings people together is a political speech or an incoming train. When the crowd becomes a little emotional, *i.e.*, when inherited tendencies are set off and run their course at lower levels, we speak of throngs, camps, settlements, concourses, and posses. If the common perceptual object is something that has been prepared for or announced but which has not occasioned a great amount of preliminary tuning we may use the terms rally, the reception, the procession, the parade, the reunion, or the meeting. All of these groups are crowds if we may be permitted to use the word in that sense.

If we speak of crowds as *more* or *less* integrated or tied together, the lowest degree of social contact would be found among mere aggregates. The collection of individuals waiting for a train or for a speaker, or the group hurrying along a street are examples of this lowest order of crowd. The members of an aggregate are not drawn together by a specific social object and yet there are probably unclear processes that make them aware of their fellows. A second level of social integration is to be found among those temporary and spontaneous gatherings whither individuals are drawn by a common object of curiosity, or of interest. An accident on the street, the passing fire engine, a cleverly decorated store window, or a novel advertising scheme will signalize the appearance of a throng.

The Audience.—A still higher degree of organization is to be found among the heterogeneous members of a group assembled to hear, for the moment, some spokesman. A crowd of this kind is characterized not only by the active operation of the perceptual functions but also by a very crude process of thinking. The crowd is to be distinguished from the audience in several respects. The social references which tie the members of an audience together have a history. Audiences are sometimes called "primed" in order to show that the members of such a group have enjoyed previous association and that they possess common interests. Congregations of this type come together for specific purposes and the members are frequently inspired by ideals of social service or devotion to a common cause at the expense of individual preferment.

The *audience* is characterized by a number of special mental dispositions. It is, for example, a receptive group. Since the interests of the members of the group are common to all, the audience assembles in a yielding frame of mind. It comes to be amused or instructed or inspired. Audiences offer no serious objections to the authority of the leader; they do not doubt his statements. The audience is also a trained congregate. It follows customs and traditions easily. Repetition of the ceremonies and rituals of a church service readily throws such a group into just the frame of mind necessary to adequate religious worship. To be with one's friends, to enter a familiar building, to expect a given topic, to get old associative tendencies reëxcited are familiar experiences of the member of the audience. Many of these facts regarding the audience can be summarized by the statement that the audience is a "polarized" group. That is to say, the speaker or the performer is an object to which individuals give collective attention. The observation of the speaker, of all he says and does, is the prepotent object of attentive regard.

Sympathic Groups.—The audience and, in fact, all kinds of societies characterized by personal contact are to be distinguished from what we may call sympathic groups. Groups of this kind are made up of individuals who, although not physically conjoined are, nevertheless, aware of one another through the newspaper or by means of ideas bearing a reference to other individuals. The term sympathic has been used to describe social integration which is ideationally determined. A sympathic group is a group united because its members have in common the services of their church or lodge, the coming celebration of a national holiday, or the contemplation of some coöperative enterprise.

The dependence of the congregate on perceptions and of the sympathic group on ideas marks a fundamental distinction between these two kinds of social organization. As one reads the morning paper and observes one's own name, one pictures to oneself a large number of individuals reading the same page and taking one into account. The mind-body state which follows is not determined by the presence of other individuals but by ideas, and the whole situation gets a character not taken account of by an individual psychology.

There are also differences in function to be ascribed to the two large groups we are considering. In the congregate the individual is more active than in the sympathic group; he incorporates himself in the group. In the sympathic group the attitude is passive; and while in the former the individual thinks of the group as including himself he now thinks of himself as a part of the group. As in crowds and audiences, so in the sympathic groups, the closeness of social contact varies. There is a loose sort of contact characterized by the mere assertion "I belong." Any chance reference or incident which draws attention to the social medium in which the individual inheres gives rise to the loose form of assemblage. At the other extreme stands the close sympathic group organized under some specific condition. It is probable that in this case there are aroused "dispositions of great age and tenacity,—dispositions which represent a multitude of relations and which serve to identify the member with his group." The degree of integration in the close assemblage probably depends upon "seasoned and complex tendencies to neural function which are the precipitates and the residues of a vast number of previous 'social' experiences."

Miscellaneous Groups.—There are other groups to be classified. We speak of the church, the party, the congress, the congregation, the association, the league, the combine, the army, the team, the family, the clan, the faction, the mob, and the horde. All of these and many more like them can be distinguished by their dependence upon specific intellectual talents. The congress, the congregation, the convention, the conclave, the parliament, the synod, the court, the tribunal, the cabinet, the senate, the legislature, the committee, and the jury are held together by perceptual and ideational factors; but they may be characterized principally as *deliberative* groups. The jury is a group in which deliberation and judgment reach the highest possible level among groups. The supreme court is a deliberative body of this kind.

The affective and the emotional side of behavior is also represented in social groups. Common feelings and family sympathy help to hold a family together. The feelings are no doubt aided by common perceptual material; but on the whole the family, the clan, the clique, the club, the tribe, the coterie, the fraternity, the brotherhood, and the caste are characterized by fairly strong affective experiences which owe their origin to and work back upon the unity of the group. When the emotional factors begin to predominate the group becomes a faction or a sect, and at high intensities it becomes a mob, a horde, a rabble, a herd, a press, or a gang.

Social Behavior Patterns and Attitudes

We have just said that patriotism, love, anger, sympathy, and rivalry cannot be understood except as they reflect the existence of social groups, the relation which one member of a group may sustain toward other members. There are a great many behavior patterns and attitudes of this sort. The words sympathy, justice, mercy, awe, reverence, shyness, embarrassment, sorrow, gratitude, imitation, etc., suggest types of human behavior which are inextricably tied to social living. Some of these behavior patterns and tendencies must be described in greater detail.

Imitation and Suggestion.—Suggestibility has been defined in a dozen or more ways and this reflects the inadequacy of our knowledge rather than our cleverness. There is general agreement, however, on what happens during suggestion. A proposition or a situation is placed before an individual and the proposition or situation is accepted and reacted upon without the usual inhibitions or processes of reflection that characterize thinking. A suggestion is a proposition to action. "In every field the individual submits to propositions for motor settings or actions which he would not perform, if he were only following his own impulses or his reason." [1] In terms of stimulus and the nervous system, a suggestion is any stimulus, situation, or instruction which sets off a determining tendency without at the same time touching off other competing tendencies. Suggestions may be either direct or indirect. In the former, a direct command from a person having prestige and authority, a parent, a priest, a captain, or a word from a hypnotist may lead to uncritical action. In the latter the source of the command is unrecognized by the subject. A straight-standing person gives us an involuntary command to square our own shoulders. We yawn when others do.

Suggestibility or the tendency to act without reflection varies under many conditions. The more intense the gregal disposition of a group the greater the power of suggestion. On the part of the recipient, a defect in knowledge, either by way of material or by way of organization and systematized belief, results in heightened suggestibility. An individual is least suggestible when he is most mentally alert and active, while fatigue, ill-health, emotional perturbation, drugs, etc., increase suggestibility. There are, moreover, wide individual differences in the way in which people are affected by events and by personalities. On the side of the agent, suggestibility is favored by his impressiveness, his strength, or his personality. A group of persons in agreement makes the illogical acceptance of a proposition particularly successful. Autosuggestion is of the same nature save that an individual propounds to himself items of belief or of conduct to which he subscribes without deliberation. A suggestion may possess added value if the proposition is cleverly worded and so stated as to disarm suspicion. In a state of hypnosis, however, a subject responds with a will to almost every suggestion made, providing the performance called for lies in the range of his previous experience and is not contrary to his deepest moral and intellectual habits. It is said that Southern people are more suggestible than Northerners, women more than men, emotional and nervous temperaments more than stolid temperaments, and the old more than the young. Suggestibility is supposed to be increased by fatigue, fasting, hypnosis, prestige, and high group emotion; it is supposed to decrease with the active use of organized knowledge or by the intent to think or to reflect.

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[1] Münsterberg, H., *Psychology, General and Applied*, 1914, pp. 256–257.

Imitation may be described as the motor phase or aspect of the suggestion-imitation phenomenon. A proposition is accepted, and it is acted upon. We perceive the details of an action (*e.g.*, a nice piece of skill) and without reflection, sometimes unconsciously, attempt to imitate the movement. Psychology is not wholly clear on the matter of imitation for there are some writers who insist upon an instinct to imitate. There is, however, nothing specific about the stimulus to imitation or about the imitative movements themselves. And the lack of the profound emotional accompaniments which belong to other instincts suggests that there is no well-marked neural disposition in this direction.

The suggestion-imitation process makes use of almost any intellectual trait; but emotions, feelings, and action are imitated more often than ideas and opinions. The socially superior, the more powerful, the more successful, and the richer are followed by the socially inferior, the less powerful, the unsuccessful, and the poorer.

Sympathy.—Sympathy, like loyalty, devotion, and patriotism, is an attitude which owes its origin to communal living and which in turn adds to the comfort of individuals in a group. Sympathy means "feeling with" an individual. It is a way of sharing life with another. It is an attitude which would be meaningless outside of companionship, for we do not have sympathy with inanimate objects save as we read human attributes into such objects.

Psychologists are not agreed as to whether we are sympathetic because we copy in our own experience the emotion (say, of fear or of sorrow) which we see in our neighbor, that is, because we take his emotion as an adequate stimulus for the arousal of a kindred emotion or sentiment in our own experience, or whether we take his emotional behavior as a sign that there is something present which might be or already has been dangerous or saddening to us also. In any case sympathy, and especially the form of it which prompts us to knit ourselves more closely with the mental lives of others (rather than merely to remove from our own experience and environment the circumstances which, in others, have led to the situation commanding our sympathy) is a powerful agent in socialization. When men enter sympathetically into the motives and interests of others the result is social unity rather than the contrary.

Laughter.—Man has been called the laughing animal, and yet there is no good reason why he should laugh. It is not enough to say that he laughs because he finds humor in the predicaments of his fellow creatures. One must still answer the question as to why anything should be humorous. Our knowledge has been confused by the belief that laughter serves no biological purpose and that, therefore, it should not exist.

We should be greatly helped if we knew how laughter came into its present status as a response to social stimulation. There are several opinions about the matter. By some it is said that being tickled is the primary joke, the original laughing matter. True it is that children can be stimulated to laughter by tickling certain sensitive zones of the body, many of which cover vital bodily organs. We have no simple explanation, however, as to how this primary response to tickling becomes intellectualized and socialized in the forms of adult wit and satire. It is said that the thrust of the parent toward a sensitive, ticklish zone in the child, which is suddenly and playfully changed to nothing, is prophetic of the fundamental nature of adult merriment, viz., the sudden transition from a strained, even fearful, expectancy to nothingness (Kant). The more sudden the transition in the joke, the greater the merriment. A joke does have a point, a turning point upon which the humor stands, but how this may be related to the turning point in a thrust at a ticklish zone is not clear. The "turning point" describes something but does not explain.

Freud has devised an interesting theory of laughter. He explains wit as the sudden release of suppressed impulses from the unconscious. This assertion will be somewhat more understandable when we have had occasion to describe in greater detail what Freud means by unconscious, repression, and the like. For the present we can make the matter clearer through an illustration. Let us assume that we bear a grudge against a dignified but officious superior. We dare not give expression to our grudge, and our attitude toward him is, therefore, repressed. But one day we see him slip upon a banana peel. All of our suppressed impulses can now find a hearty and "safe" outlet through laughter. If this principle is extended to repressions of all forms of hostility, dislike, sexual desires, and the like, we see why laughter comes to have a biological value, and why it is a permissible way of settling our accounts with a particular part of the total social situation. Laughter is a way to settle some of the conflicts which arise because of social factors.

The Effect of a Group Upon Individual Performance.—There are almost no experimental studies in social psychology and *facts* about social groups are wanting. There are indications, however, that groups may affect the performance of individuals in the group. In a study of the grades gotten by university students who were seated in different parts of a room it was found that students on the outskirts of the audience were more apt to get a low grade than students in the center. Since the lower averages fell not only at the back but at the sides and even at the very front of an audience, the inability to hear the lecturer or see the demonstrations could not be invoked. Moreover, the center area of higher averages traveled with the size of the audience, so that in a large audience the area of high grades very often coincided with the area of low grades for a small audience. From these and from other facts the conclusion was drawn that individual differences in performance may be due to the degree of social integration. Individuals in the periphery of a crowd are apt to be restless and inattentive to whatever may be attracting the interest of the main group, whereas physical compactness and the interests and activities of a group polarized toward the speaker may knit together the main body of an audience. In other words, the heart of an audience is organized not only toward the speaker but with respect to itself. Its internal organization favors individual achievement.

Conflict and Repression.—The individual is often at war with the conventions and habits of society. Youth is often at war with maturity. There is conflict which is settled either by a modification within the social group or on the part of maturity, or (and this takes place more often) by an act of repression upon the part of the individual. Unfortunately this second mode of settlement is only temporary and is conducive to many forms of mental derangement, and we shall have to consider it in detail in a later chapter; but the problem is also a problem of social psychology and we shall, therefore, state it in more detail at this time.

It is not necessary to wait until psychologists have settled their present argument about the existence of instincts before the science can realize the tremendous power of unlearned urges to get food, to acquire a mate, and in other ways to express the will of the individual. The power of these tendencies is reflected in the fact that although the individual does not often come to overt blows with society (the oppressor and enemy of full self-expression), he may go on throughout his whole lifetime in a raging *covert* struggle. We may give an illustration. A doctor is called upon to aid a man who stands in the way of his professional advancement. In spite of humanitarian and professional ideals the impulse to be a laggard in his administrations starts a conflict between his ambitious self and his humanitarian self. This somewhat superficial example may be extended as far as one wishes to extend the driving forces of life.

Of these forces, the sex or parental instincts have often been urged as the most fundamental. Society has made it impossible for the individual to go his limit in the gratification of these impulses and if they have not been properly conditioned during infancy and childhood the adult finds himself the victim of warring impulses. Since this has become a cardinal feature of the Freudian psychology we shall leave it for later consideration (p. 386).

Another type of conflict occurs between incompatible systems of ideas and beliefs. There is, for example, a fairly common warfare waged between religion and science. Some of these conflicts have been known to unbalance an individual unless the trouble can be avoided through conversion. Conversion is one of the most remarkable ways that has ever been discovered for resolving conflicts, especially of the moral and religious type, and it will deserve our attention, therefore, toward the end of the next chapter.

CHAPTER X

THE MONUMENTS TO MENTAL LIFE

Introduction.—Let us indulge in a fantasy for a moment. Let us assume that we are thoroughly conversant with the world in which we live. We shall suppose that we have traveled much, that we have seen the wonders of the Alps, the crumbling pyramids of Egypt, the majesty of the Himalayas, the curious peoples of isolated islands, the art galleries of a dozen cities, museums, bridges, monuments, canals, everything, in fact, that travel can bring before us.

And now let us look at this same world again, but this time let us assume that it is a world upon which man has lived but a year. What a change we should find! The caves of France would yield us no chipped stones or engraved walls; the plains of the Tigris and Euphrates rivers would yield no ruins of once magnificent cities, and there would be no baked clay documents of a civilization that is almost prehistoric; the Nile river valley would be unbroken by huge pyramids of stone and temples to sacred deities; there would be no wall across the northern boundary of China; the remains of a glorious Aztec civilization would not exist; the monumental figures which adorn Easter Island in the southeast Pacific would not stand as a mystery to explorers; no evidences of unique intellectual achievement would be making Guatemala and Honduras a center of interest to ethnologists and anthropologists; we should not be able to worship in Gothic cathedrals nor stand in awe before the Taj Mahal. The earth would be stripped of every purposely overturned stone, every piece of carved rock, every form of ancient habitation, every weapon, every utensil, every evidence we have of the existence of creatures antedating us by a shorter or longer period of years.

We should also miss something else. There would be no libraries, no language, no writing, no other symbols of thinking; there would be no art galleries with beautiful portraits and landscapes; there would be no sculpture, no music, no drama, no history, no customs, no conventions, no fashions, no institutions, no religions.

Monuments to Intelligence.—It is, of course, a fantastic picture which we have drawn. We make use of it only to show in a vivid way what man has done to the world. He has changed it, he has added to it, he has erected a great number of monuments to his own living. He has not only changed the natural world but the very fact of living has led to a change in the way of living. This we see when we try to realize what living would be without language, without customs, without institutions, without religion, without beliefs, modes of behavior, and convictions which presuppose ancestors. Every human being has made himself immortal by living again in the physical changes he has brought about in nature or by living again in the habits, customs, and beliefs of his children's children.

The Psychological Value of Primitive Culture.—Old river valleys, mountain chains, trees, and other natural objects also leave traces of their having been, but not in the same sense that man has immortalized himself. The structures and habits of which we here speak call for more than the existence of a living creature. They presuppose the activity of beings which were creative enough to change their environments,—improve them, take advantage of them, or find enjoyment in them.[1]

The products of intelligent living throw a brilliant light upon two chapters of psychology, viz., upon genetic psychology and upon social psychology. If we are very cautious in our use of the idea we may say that the thing created suggests something about the character or the abilities of the creator. Chipped stones, on the one hand, and a twelve-inch rifle, on the other, imply a difference in intellectual talent. Crude pencilings on the walls of caves, gross means of communication through gestures, in fact, all the traits and characteristics of early human beings throw an interesting light upon the history of intelligence in the race.

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[1] Read Wundt, W., *Elements of Folk Psychology* (tr. Schaub), 1915.

But these monuments to primitive intelligence add value also to the chapters on social psychology. These monuments are not the work of a single individual. It is hard to see how one man could have invented a language. Language could arise only when there was someone to speak to, when one individual found it necessary or advisable to convey to another by a gesture, ejaculation, or symbol, some bit of knowledge in the form of a warning or an invitation. In the same manner, art, music, customs, and religion have little meaning unless they are considered as the product of group activity. These beliefs and habits are products of coöperative living and they are, therefore, inexplicable in terms of a psychology that studies man without considering the social phases of his environment.

Thus the study of the beliefs, traditions, customs, and habits of primitive people furnishes material for two chapters in psychology, viz., genetic psychology and social psychology. Primitive societies help us to understand how man became a social creature, and they help us understand the differences between his own mental life and our own.

LANGUAGE

We commonly use the word language to name an elaborate system of verbal sounds or written words together with an equally elaborate set of rules which determine the use of the sounds or the words in any sort of communication. Psychologically and genetically, however, language refers to any means of communication whatsoever. Verbal means of communication which recommend themselves to us because of their efficiency, were preceded by other much cruder means.

Origin of Verbal Language.—The origin of language probably lies in those half-involuntary expressive movements which an animal makes to sudden changes in the environment and to instinctive urges in itself. We have no reason to suppose that, as a result of a human impulse to speak, man found himself one day using words. It has been said that man had ideas and thoughts, and that in striving to express himself he fell upon verbal sounds as an adequate means. This is neither science nor good speculation.

The emotions and primitive involuntary movements of early men or of the higher animals led, as we may imagine, to gestures, to pointings, to verbal ejaculations. Common original nature led no doubt to common modes of expression commensurate with common modes of feeling. The decisive step was taken, however, when one animal took the involuntary gesticulations of another as a sign or a symbol of some object or event. When a gesture or any other expressive movement became an invitation or a warning, language was born. A second notable step was taken when one animal made movements, gestures, or grimaces with the *intent* to warn or to invite, to amuse or to pacify another animal. Which step was taken first we have little means of knowing, although a perception of movement which pointed to danger or implied some object seems psychologically simpler than an intent to create such an impression.

A normal process of trial and error would lead to the improvement of the means of communication. A definite act of pointing would, for example, recommend itself by its efficiency. To gesturing, pointing, grimacing, and the like was added the graphic means of indicating an object. Sketches drawn in the air or upon sand or upon the walls of a cave came to symbolize objects and events. The picture of an animal on the wall of a cave might readily mean an important event in the life of a tribe. Dancing served the same purpose. The primitive dance is more often than not a semisymbolic re-living of a fruitful hunt, a victorious campaign against enemies, an unsuccessful or successful wooing, etc. Some day it may be possible to show in detail how certain sketches and certain dances became more or less permanent and habitual to given groups and so furnished the basis for ceremonial dancing, on the one hand, and pictorial writing, on the other. We shall, no doubt, be able some day to show in detail how the process of symbolization was simplified by dropping out parts of a drawing, with the result that in the end the written or drawn object was nothing but a pure symbol. In the later stages of Chaldean script or Chinese script the graphic means of expression is already so schematic that the original figures have been lost. Once a graphic symbol became a permanent part of the lore of a tribe, written language was born.

Among the many movements made by animals and primitive man were vocal movements issuing in sounds which may have become symbolical just as simplified drawings became symbolical. Like pointing or graphic expression, a vocal sound may have come to represent or stand for the object or event which originally excited the ejaculation. In some such way verbal language may have been born. It is a matter of argument as to how large a part the noises of nature played in this process. There is a theory of the origin of language which states that words came during the attempts of men to imitate natural sounds. The *hissing* of steam, the *crashing* of thunder, and the *murmur* of a brook illustrate the degree to which spoken words may resemble natural sounds. We may be doubtful, however, as to whether such imitation did more than suggest varieties of sound quality.

The Growth of Verbal Language.—We commonly speak of language as a vehicle or an instrument of thought, but it is obvious to students of primitive language that it is rather a mode of action, a way of behaving than a vehicle of thinking. This we have already found to be the case with infants. The word is a conditioned response to an object or event and comes to stand not only as a substitute for the object or event but often as a substitute for some other more heroic and wasteful mode of response.

An interesting light has been thrown upon the development of language as it stood just prior to the creation of class names. The Australians, for example, have no class meanings for the words tree, bird, or fish, but they do have a word for every kind of tree, bird, and fish. The Indians have a large number of words to express the forms in which the clouds appear. The Lapps have twenty names for different kinds of ice, forty-one words for different types of snow. Or again, the natives of British New Guinea have no word for walk, but they do have words to express walking toward the north, the south, the east, and the west. Other tribes are known to have words for every type of walking, for slow or fast, or cautious or reckless walking. In other words, the native (and the child as well) has a verbal substitute for every phenomenal change in the environment.

Law

It is a maxim of the Talmud that custom always precedes law. In the Justinian code it is said that "long prevailing customs, being sanctioned by the consent of those who use them, assume the nature of laws." In a similar way, it is said that taboos form the basis of certain penal codes and that the fact of taboo gives a warrant for punishment. It is well known that the common law of England and, consequently, American law, is largely a written record of the customs of Englishmen. So closely is law dependent upon custom that it has even been urged that no law can be enforced against a prevailing custom.

These facts suggest that law, like language, has had a history, that men have not sat down in the full maturity of their intellectual powers and worked out the basic principles of our legal code. They suggest, rather, that these principles had their origin in primitive society. We must consider, then, the argument that laws and the penal code are customs and taboos that have been recently written down in books.[1]

Taboo.—We may suppose that originally primitive man was subject to the power of his own hereditary tendencies. He behaved as nature made him behave. But in group life original nature was modified. His own instinctive life was soon overcast with aids or hindrances which sprang from the life of the group itself. That is to say, as we look back upon primitive peoples we discover them actually inhibiting certain otherwise legitimate impulses toward conduct and thought. The inhibition does not issue from some process of reasoning and it is not written down or commanded by word of mouth, and it is not always related to objects or to events which are immediately dangerous or unpleasant. On the contrary, the inhibition seems to spring from an habituational tendency which carries a negative instruction. Such a restriction on native impulses is called *taboo.* The taboo does not necessarily imply moral judgment. It is a standard of negative conduct that affects every form of primitive life. It is a way of acting that belongs to groups in much the same manner as habits belong to individuals.

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[1] See Read, C., *The Origin of Man*, 1920.

We may draw an illustration of taboo from the Snake dance of the Hopi Indians, a tribe of our own Southwest. At a certain season of the year and with due preliminary ceremonies, selected men from the tribe go out into the desert and bring back to the villages as many snakes as they can discover. Since their creation legend implies that the Hopi Indians are descended from the Snake family, all reptiles are regarded with reverence; and the Hopis enjoy a peculiar immunity from bites and poisons. During the course of the ceremony—which is a prayer for rain—the snakes are purified and deposited in what is called the snake *kiva.* Now it is the belief among the Hopis that only the high priests may enter the snake kiva. The cavern is holy ground and the penalty for trespassing is death under frightful conditions. In other words, the snake kiva of the Hopi Indians is under a taboo. A taboo, then, is a sort of negative custom, a way of protecting objects or individuals or of avoiding the impurities that primitive man finds about him.

Totem.—A common form of taboo is connected with the worship of a totem animal. Somewhere in the process of mental development certain tribes came to sanctify an object, or more often an animal, as the totem object or animal. Originally the word "totem" may have signified a group of individuals, and finally the clan or totem group came to bear the name of the totem animal. Frequently, however, the totem animal is regarded as the ancestor of the group and is looked upon with great reverence. The totem animal is not to be harmed or to be partaken of as food on penalty of death or of dire disease and anguish. It is thought by some that the taboo had its origin in this negative instruction toward the totem animal. Other origins have also been urged; but taboo, as we know it among primitive peoples, had a wider significance than the tribal animal or any other sacred object. Whatever its origin, the taboo came to be a general mode of behavior under which the right to touch objects or persons, or the right to behave in certain ways was denied by society.

An object was taboo or to be avoided for two reasons, first, because of its sanctity, and second, because of its impurity or loathsomeness. If we may suppose, for the moment, that taboo originated in the totem group, the totem animal came to be an object of reverence and to eat of it was an act meriting punishment. The person who, for any reason, did partake of the totem animal became taboo in turn; for by that act he became impure and subject to expulsion from the totem group.

Applications of Taboo.—The development of the idea of taboo as applying to other objects was probably universal among primitive peoples. As a matter of fact, the taboo is now known to have been exercised (*a*) in the protection from all harm of important persons, chiefs, priests, or visitors; (*b*) in safeguarding sick or weak individuals; (*c*) as a provision against danger either from actual physical enemies or from the spirits of the dead; (*d*) as a safeguard to the sanctity of the chief acts of life such as birth, initiation into adulthood, marriage, and death; (*e*) as a protection against the wrath of the gods or as a warrant of their favor in the production of good crops or engagement in successful hunting expeditions; (*f*) as a security to children who enter unknowingly into forbidden places and meet with disease or other misfortune; and finally (*g*) as a protection against marauders and the destruction of property. It is apparent, then, that primitive life was hedged about in a thoroughgoing manner with all sorts of restrictions—restrictions not written down in words, but carried from mouth to mouth and from group to group, always getting their sanctity by long continued allegiance to them and by public approval or disapproval.

The sanctions of the taboo were thought to be either direct or indirect. In the first case, it was supposed that the violation of a taboo would result immediately in its own punishment by the working of some magical law or because of the animistic belief in the wrath of a god or of the spirit of a deceased member of the tribe. In the second case, the sanction of the taboo was indirect or given by the group, which reserved the right to administer its own punishments.

Frequently, violators of a taboo were themselves tabooed and it was supposed that taboo was transmissible from one person to another. Taboos were either temporary or permanent, depending upon the nature of the offense and upon the process of purification necessary for their removal. The chief purification agents were water, fire, and magical transference. "Just as water removes physical uncleanness, so also does it wash away soul or demoniacal impurity,—not symbolically, for primitive man has no symbols in our sense of the word, but magically. As water is the most common element, so also is it the most common magical means of lustration. Besides water, fire also is employed; generally it is regarded as the more potent element—at any event its use for this purpose anteceded that of water. . . .

"Less common, on the whole, is the third form of lustration, that by magical transference. Israelitic legend affords a striking example of such lustration in the goat which, laden with the sins of Israel, is driven by Aaron into the wilderness. He takes the goat, lays both his hands on its head, and whispers the sins of Israel into its ear." [1]

Taboos are group standards of conduct. They do not grow out of conflicting tendencies and neither are they products of deliberation. There is the simple command: "Thou shalt not."

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[1] Wundt, W., *Elements of Folk Psychology* (tr. Schaub), 1916, pp. 201–203.

The command often carries more personal reference than other norms of conduct and the taboo is frequently accompanied by considerable emotion.

Custom.—Custom is a sanction of positive character. It represents the "Thou shalt" of society. It is any form of positive action which has been developed in a social group and which has come to determine individual or group conduct. Custom may be the outgrowth or accumulation of individual habits; but as a custom the individual habits become "social habits." A habit is an individual way of acting. A custom is the precipitation of several generations of individual habits. Both are acquired modes of behavior.

Habits differ from individual to individual. Customs are common to a whole group; but they may vary widely from group to group or from community to community. Both habits and customs are established firmly by repetition, and both are modified or eradicated only by the most serious efforts. In both habit and custom the end to be gained by the performance has dropped out. The performance is completed without reflection and apparently without the intent to achieve a certain result. The motives that initiate and establish habits and customs may also disappear.

Just as taboo was enforced by the influence of a totem group so custom is enforced by social sanction. Customs represent the crystallization of the experiences of a group, and the group, therefore, holds tenaciously to them. Its sanction is imperative and is usually adequate to the continuance of the custom. Customs are, then, a conservative element in society. They present, as do habits among individuals, a sort of inertia to change.

Finally, customs center largely about the more serious affairs of life just as is the case with taboo. More trivial social events are regulated by conventions, by manners, by usage, and by etiquette; but methods of burial and codes of mourning, wedding ceremonies and baptism, and many ways of acting are safeguarded by well-established customs.

The characteristics of a good custom have been enumerated as follows: (*a*) The custom must have been used so long that "the memory of man runneth not to the contrary"; (*b*) it must have had continuous use; (*c*) it must be enjoyed peaceably; (*d*) it must be reasonable; (*e*) its sanctions must be adequate to its continuance; and (*f*) it must be consistent with other customs. A custom is subject to change only when the conditions of life are changing and new standards of social conduct and thought are imperative.

Convention.—A custom is a way of thinking or acting which we inherit from our ancestors. White people dress because it is customary, and bushmen go without clothes because that, too, is customary. The presence or absence of clothing is a fairly constant and enduring tradition. Conventions likewise refer to group modes of behavior like customs save in one respect, viz., that they are more temporary and less significant. In custom we imitate our ancestors but in convention we imitate our contemporaries. It is said that the socially inferior imitate their superiors, that powerful men, groups, or nations are imitated, that successful men are imitated, that the poor fellow imitates the rich, and that the city leads the country. This means that society is so organized that the habits of one group may set the limits of action of another group.

Among these cross-sectional ways of social acting may be numbered fashion, fad, etiquette, manners, and the like. The distinctions between fashion and custom are based upon differences in scale and permanency and upon a difference in the mode of enforcement. Fashions and fads are intermittent and ephemeral social impulsions and they refer mostly to modes of dress. Society adheres to one style of dress for a few months and then shifts to another as the seasons change or as other factors, which we shall presently name, become operative. The custom is a fairly permanent mode of behavior and it is unaffected by the conditions to which fashions are subject. The difference in the mode of enforcement, however, is a more fundamental difference and one that lies nearer to psychology.

We have found that customs are adhered to because of an unlocalized yet powerful thing called social approval or disapproval; but fashions and fads are adopted by deliberate imitation or because of conscious self-regard. To wear some form of clothing is customary. To wear a certain form of clothing may be customary. But to wear many changing forms is fashionable. Fashions, then, are temporary modes of community action. They are not social habits but mere whimsicalities, especially when they descend to the level of fads. Fad stands related to fashion and fashion to custom as a riplet stands related to a wave and a wave to the tide.

Fashions and fads may be initiated (*a*) by individuals who desire to be distinctive and give expression to their self-regard; (*b*) by industrial establishments seeking to improve their trade; and (*c*) by national events or unusual personages and occurrences. We had during the Russo-Japanese war, the kimono; during the Roosevelt presidency, the teddy-bear; during the Wilson régime, the Wilson purple; and still more recently we have had the Harding blue and Tut-Ankh-Amen prints.

CHAPTER XI

THE PSYCHOLOGY OF RELIGION

Introduction.—There are three things about religion that bring it into any general survey of psychology. In the first place, the origin and development of religion, like the origin and development of language, give us a very satisfactory picture of certain phases of primitive intelligence and also some suggestion of man's increasing intellectual powers. In a certain very general sense the history of religion is a history of man's attempts to relate his total life to the total meaning of nature, to settle his accounts with objects, powers, and agencies suggested by his environment. We assume that he has been increasingly able to do this and the history of his attempts at casting up such a balance renders an insight into his earliest modes of thinking. In the second place, religious types of mental life and religious modes of behavior offer an interesting supplement to our total account of the intellectual talents. Prayer, worship, and conversion are three extraordinarily interesting phases of the life of men. The act of prayer and the conditions under which it may be made most effective, the acts of worship, and the phenomena of conversion have more to do with living, with successful getting on in the world, than most psychologists have been willing to admit. In the third place, religions, like languages, customs, laws, and other products of communal life are effective agencies in maintaining communities and giving them a distinctive character. In religion, societies have created one of the ways they have of preserving themselves.

Definitions of Religion.—Formally speaking, religion is theology, a logical and critically arranged system of assertions about a Deity, about morals, forms of worship, etc. But psychology has no more interest in theology than it has in philosophy.

Psychologically regarded, religion implies a unique type of experience and unique modes of behavior; but from this point forward our way is beset with difficulties. In spite of the difficulties, however, let us essay a provisional definition, for we must have something concrete about which to gather our subsequent discussion.

In the first place, we are using the term "religion" in its broadest possible meaning. We do not refer to any single religious system or to any specific kind of experience. We mean to include under the word "religion" all the experiences and the performances of modern as well as of primitive social groups that involve, directly or indirectly, an appeal to some power or powers not immediately present to the members of the group. By including so many various experiences and practices we hope to find running through them a common thread that will lead us to the experiences and to the behavior of the religious worshiper.

This first step in our definition is simple enough; but to proceed further brings difficulties. Let us propose for the sake of establishing coherence in our discussion, that religion is a name for a very large group of socialized performances in which an attempt is made to secure, from an outside source, assistance in the business of living. Although there are wide variations in the nature and in the complexity of these performances, and also in the experiences which accompany them, they stand, nevertheless, as a common factor in almost if not all religious systems. Men in all ages have felt themselves dependent upon something,—upon their fellows, upon nature, or upon some supernatural power.

Primitive man used his religion almost wholly for the sake of operating successfully with nature and against his enemies. Many of his performances and ceremonies were devices for getting some power or force, some alleged ancestor of his social group to bring rain, to assure protection, in short, to moderate all the adverse conditions against which he had to contend. It seems to be a characteristic of all primitive religions that the experiences and performances of the worshiper were not an appeal for aid through himself but an appeal for the direct action of power or force upon the adverse conditions. His own experiences and the conduct of his own life were secondary to the operations of an outside force or power upon nature.

As the conception of a deity began to grow and as religion assumed a more elevated rôle in the life of social groups, the locus of divine operations changed from nature to man himself. Ritual and ceremony became prayer. Under the new point of view the world was not adverse because of the evil spirits residing in its various parts but because man himself was unworthy of a better world. The heart of the belief was the same, viz., aid from an outside force; but now man needed aid in governing his own life and his own social relations in such a manner as to merit the mercy of his God. Formerly man sought to appease a spirit that had brought disease; now man seeks forgiveness for a fault that has merited disease as a punishment. Formerly, devices were used to get good spirits into weapons in order to fight well against one's enemy; now man seeks for strength and accuracy in his own muscles and courage in his own heart.

Moreover, the temporal direction of man's concern has changed. With the development of religion and with increased knowledge about the world, man began to seek aid not merely to enable him to get along in this world but to prepare himself for a future life. The belief in immortality came relatively late in the history of religion; it was one of the products of the new significance which religion came to have for the individual and for social groups. Finally, under the belief that man needed aid to live rightly, religion acquired a tradition or a history of the dealings between God and man. These dealings have been collected in the various sacred writings of religious systems.

A large part of modern religion turns upon acts of worship and of adoration to a God who can give aid in personal living and who assures to man a future life. As religion has become a matter of personal experience and of personal relation to a Deity, the range and emotional value of religious experiences has widened. Attitudes of dependence and of human helplessness, on the one hand, and of awe and reverence, on the other, are now enlarged in significance and in intensity so that the relations between man and his God stand upon a different level than was possible in the days when gods and spirits were alleged to inhabit stones and rivers and trees and the implements of war of one's enemies.[1]

The Origin of Religion

We may quickly lay aside two theories of the origin of religion. It will not do to say that man is religious because he has a religious instinct. The problem would then be to find out how he came by the instinct. Neither has it been satisfactory to assume that Deity made man acquainted with religion through personal conference or even through revelation. Animals have no religion, some primitive men have no religion, and men are by no means agreed that the practices of all primitive men throw any light upon the problem. For a great many years, however, the opinion has been growing that religion stands in some intimate relation to magic and to other primitive modes of behavior. It will accordingly be instructive to consider the nature and significance of primitive magic.

The Relation Between Magic and Religion.—At least three theories are prevalent concerning the origin and the nature of magic. In the first place, magic has been taken as a mode of behavior entirely different from the religious mode and recognizable by certain characteristics which signify that it has had an origin distinctive from religion. From this point of view magic is believed to be a sort of primitive science based chiefly upon imaginary laws which are supposed to operate with the same regularity that we now attribute to the laws of science. It was inevitable that primitive man should become cognizant of certain sequences and coincidences which implied a causal relationship. It was more or less natural that he should seek to establish again the conditions which went along with or seemed to produce an effect that he held to be desirable. His notions as to the causal relations or as to the effective agency might be crude; he might have none at all; but he was a scientist in that he did attempt to control nature by controlling or instituting appropriate conditions. This would not be religion.

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[1] Read Hopkins, E. W., *Origin and Evolution of Religion,* 1923.

The second mode of thinking about religion and magic brings the two into more or less intimate contact. As a matter of fact, there may have been no magic-and-religion to the earliest men. It is easy to see how they would read their own feelings into objects and events, or conceive of trees, rocks, storms, and animals motivated like themselves. Man's magic would then become not only a mode of control but a mode of propitiation. This amalgamation of magic and religion will be a little clearer when we have considered the origin of animism.

In the third place, magic has been considered as a degenerate form of religion. In this sense, magic means almost the same as superstition, for superstition consists of beliefs in the efficacy of powers and forces that have been dropped by the social group as a whole. There are, as a matter of fact, certain practices to be found among primitive groups that are carried out in secret and without the approval of the major portion of the group. These practices are often magical or superstitious in the sense in which we are now using the terms.

Types of Magical Practice.—Magical practices have been said to take three forms. The first form, imitative magic, is illustrated by the savage who hopes to bring rain by sprinkling water upon the ground. "Public ceremonials for the production of rain by imitating its fall are widespread; for causing the sun to shine by rekindling its light with fires or by other means of renewing its waning strength; for making the wind to blow by flapping blankets to start a breeze. . . . In ancient Peru, when a war expedition was contemplated, they were wont to starve certain black sheep for some days and then to slay them, utter-ing the incantation, 'As the hearts of these beasts are weakened, so let our enemies be weakened.'" The Hindu, in order to destroy his foe, "would fashion a figure of him in clay and transfix it with an arrow which had been barbed with a thorn and winged with an owl's feather. Or he would mould the figure of wax and melt it in fire. Sometimes effigies of the soldiers, horses, elephants, and chariots of a hostile army were modeled in dough and then pulled in pieces." [1]

The second form of magic is known as sympathetic magic. The important part in the efficacy of sympathetic magic lies in possessing some part of an animal or person in order to derive its qualities. "When a Zulu army assembles to go forth, the warrior eats slices of meat which are smeared with a powder made of the dried flesh of various animals, such as the leopard, lion, elephant, snakes, and so on; for thus it is thought that the soldiers will acquire the bravery and other warlike qualities of these animals. It is a commmon practice to eat the flesh, particularly the heart, and to drink the blood of brave enemies in order to acquire their qualities." [2]

The third form of magic, and one hardly so common as the other two, is called direct magic. Among primitive as well as modern peoples, there were individuals said to possess the ability directly to affect objects or persons at a distance. A king's gaze was supposed to be so powerful as to operate immediately through space, affecting persons or even such an object as the sun itself.

All that primitive man did, apparently, was directed toward the possibility of controlling powers that were too great for him. Nature was too much for him; his enemies might be stronger than he himself; the mysteries of life and death were beyond his comprehension; and he appealed, therefore, to the simple causal relationships he saw about him or to the spirits and beings his observations had suggested in order to compete more successfully against an adverse world. It is out of this sort of belief that religion is supposed by some to have come. Successive appeals were made to more powerful beings until finally omnipotent beings were alleged to exist who must be propitiated and served if advantages were to be expected.

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[1] See Ames, E. S., *The Psychology of Religious Experience*, 1910, p. 82.

[2] *Ibid.*, p. 83.

It is not impossible that a religion should have arisen in this manner and neither is it impossible that the belief in invisible spirits or powers should have been prior to either magic or religion. In this later case it has been urged that religion grew out of the magical practice of the group while magic proper was identified with private manifestations of superstitious belief. At any rate religion and magic are inextricably bound together in many primitive societies.

Animism.—"In anthropology, the term Animism is usually employed to denote the proneness of savages and barbarians, or peoples of unscientific culture, to explain natural occurrences, at least the more remarkable and interesting—the weather, the growth of crops, disease, and death—as due to the action of spirits: (*a*) ghosts (that is, spirits that have formerly been incarnate); (*b*) dream-spirits, that have temporarily quitted some body during sleep or trance; (*c*) invisible, living, conscious beings that have never been incarnate." [1]

The origin of animistic beliefs has caused much speculation. There must have been a stage prior to the beliefs described above during which animism implied a belief that all animate and inanimate objects possessed either a consciousness or at least a will and a purpose like our own. Still further back there must have been observations upon which such beliefs could be established. The "ghost theory" begins with dreams in which the dead are met again or in which the dreamer takes long trips, has great hunts, and in other ways lives a double existence. Moreover, there was the observation that the living body, a thing of force and of activity, is after death inert and cold. Finally, primitive man had vivid hallucinations, hypnogogic images, and visions as convincing as his dreams and sometimes as convincing as his daytime experiences. From such experiences as these, says the ghost theory, came the idea of a "separable conscious personal force, or spirit that leaves the body at death, and serves also, as it gathers strength, to explain sleep, fainting, epilepsy; and sometimes every sickness is attributed to the partial detachment of the spirit. . . ." [1]

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[1] Read, C., *The Origin of Man and of His Superstitions*, 1920, p. 145.

Shortly animistic beliefs were extended to animals and inanimate objects. There is power in the wind, in the waves and in lightning. There is an obstinate kind of inertia about heavy objects. Moreover, physical objects played an important part in dreams. Whatever logic primitive man had would teach him that physical objects couldn't go along with his spirit during the night. They, too, must have a double like the double of his own body.

Other theories explain equally well, if not better, the origin of beliefs in non-material powers, forces, and souls. Whatever their origin, the extension of these beliefs into religion and philosophy is a matter of written history. "Belief in ghosts led in time to the worship of ancestors, and then especially to the worship of the ancestors of chiefs or heroes, some of whom became gods; and the belief in gods strengthened the authority of chiefs and kings who were descended from them, and helped to maintain the unity of the tribe or nation from generation to generation and from age to age." [2]

Ceremony.—At a certain season of the year it has become customary for the only remaining Samaritans to leave their little town of Shechem and ascend Mt. Gerizim in order to celebrate, in commemoration of the night of the Passover and of the flight of the Israelites from Egypt, the Feast of the Passover. Several days prior to the night of the feast, each Samaritan purchases a lamb "without blemish, a male of the first year," and, together with his family, pitches his tent upon one of the slopes of Mt. Gerizim. Here has been prepared "an altar of earth" which is lined with uncut stones; for it is written that "if thou lift thy tool upon it, thou has polluted it." Upon this pit are placed two large copper kettles and near at hand is another large pit in which the lambs are to be roasted. Toward evening the ceremonies begin. The Samaritans, robed in white, slowly gather, and placing on the ground small prayer cloths, stand with bared feet facing their Holy of Holies. Led by a venerable high priest, the service begins with a prayer written centuries ago. The prayer is repeated in concert, the rows of older men and the priest kneeling with their hands outstretched to heaven whenever a petition is asked. Before all prayers, the Samaritan goes through prescribed ablutions, washing with water three times each the hands, mouth, nose, face, ears, and feet. When the prayer is ended all rise and remain erect while repeating silently the five articles of their creed,—belief in God, Moses, the Pentateuch, Mount Gerizim, and the Day of Judgment. Other prayers are said and parts of the scripture are repeated until the time for the slaying of the lambs has come. As the word "slay" in the passage "then shall all the convocation of the assembly of Israel slay it between the two evenings," is spoken, the lambs are deftly slaughtered and prepared for roasting. The slaying takes place between the two evenings, that is, between sunset and dark according to the command: "Thou shalt sacrifice the Passover in the evening, at the going down of the sun, at the very time thou camest out of Egypt."

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[1] Read, C., *The Origin of Man and of His Superstitions*, 1920, p. 155.

[2] *Ibid.*, p. 155.

As the slaying proceeds there is great joy among the assembled worshipers, for sacrificial rites are an integral part of Jewish life. One of the younger priests collects a quantity of fresh blood in a basin and with a bunch of wild thyme vigorously stirs it, then rushes away to put a dab above each tent door in remembrance of the houses over which the death angel is said to have passed during the Passover night. At the same time bitter herbs and thin sheets of unleavened bread are given to the worshipers. Boiling water from the cauldron is poured over the lambs to make the plucking easy. As each lamb is fleeced it is thoroughly inspected to insure that no blemish remains and that no bones have been broken and that the flesh has not been torn. A deep incision is made in the flanks in order to take out the sinew corresponding to the one which was withered by the touch of the angel with whom Jacob wrestled. Other deep gashes are made in order that the salt may penetrate the body; and the right shoulder and parts of the head are removed for special roasting for the high priest and the males of the priestly family. All these things exemplify the laws and principles of custom and taboo.

Finally, the lambs are set to roasting in large pits and the worshipers gather again for prayer. Toward midnight, the camp begins to stir with unwonted activity. Every one seems to be in haste. With great shouting the cover is taken from the roasting pits and the Samaritans, girded for travel and bearing a staff or cane as did their forefathers in the departure from Egypt, assemble for the Feast. As the high priest cries reverently, "In the name of God I call, 'Hear O Israel, our God is one God,'" the meat is sprinkled with minced bitter herbs and is eaten with unleavened bread. The meat is pulled from the bones with the fingers and great care is taken to avoid breaking any bones. "And they shall eat the flesh in that night, roast with fire, and unleavened bread; and with bitter herbs they shall eat it. And thus shall ye eat it: with your loins girded, your shoes on your feet, and your staff in your hand: and ye shall eat it in haste: it is the Lord's Passover." Within a few minutes the Passover Feast is ended. All remains are gathered and burned, for not one shred must fall into the hands of Gentiles. After all has been burned the worshipers retire to their tents for a few hours' sleep; for on the next day, the Sabbath, comes the first day of the feast of unleavened bread.[1]

The Passover Feast illustrates the nature of ceremony and of ritual. Ceremonies are taboos and customs which have become systematized and which guarantee from year to year a proper attitude toward the object of religious worship. Formerly the rite and the ceremony were forms of magic. They have been built up by age-long accretions. They give concrete expression to beliefs, practices, and beings which cannot be visualized in any other way.

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[1] See Whiting, J. O., "The Last Blood Sacrifice," *Nat. Geographic*, 1920. Vol. 37, pp. 1–46.

THE EXPERIMENTAL STUDY OF RELIGIOUS EXPERIENCE

It would be unnatural indeed if a social activity so widespread as religion did not fall under the scrutiny of the mental sciences. In religion we find a state of belief and of experience that has led to the acquisition of property valued in the billions, that has been a tremendous influence in the political destiny of nations, that has affected seriously the physical and mental lives of individuals, that has driven men to and sustained them through long and bitter wars, that has enabled individuals to bear privations and pain, even to death by fire and by torture, that has furnished other individuals treasured experiences in the form of mystical appreciations of God, that has sent many an individual through the whole gamut of the emotions, that has propounded some of the most persistent problems of philosophy, that has been the most active enemy of science.

But the social and external aspects of religion are no more interesting and important than the religious experience itself. The "religious consciousness" has only recently become amenable to laboratory description. Enthusiasts in religion have taken the attitude that religious experiences are inscrutable and that their sanctity must not be invaded. The psychologist, however, has insisted that mental events in any and all forms are the subject matter of his investigation; and the results obtained in other fields justify his claim that the mental life and behavior patterns which appear under religious conditions ought also to be studied.

The primary task of the psychologist in religion is description. He does not propose tests of the reliability of religious experiences; but he asks what kinds of behavior patterns and what psychophysical functions appear during acts of religious worship and during prayer and conversion. He may, along with the philosopher, reflect on the value of religious experience and speculate upon the experience of the mystic who is said to enjoy a unique kind of knowledge; but his experimental task leads to description.

Sources of Information.—To this end the following sources of information have been explored. The psychologist has sought, first of all, to discover individuals in religious states of mind. He does not attempt to arouse this emotional consciousness artificially, but he does seek to come upon a worshiper when religious experiences are appearing spontaneously. This source is open to the objection that it is only by chance that observations can be made upon experiences of this kind. The ideal method would have a religiously-minded observer report his experiences in the same critical manner as other experiences are reported upon in the laboratory. This has been done and it has produced valuable information, but there is something in a religious experience that lifts the individual beyond himself. Parts of the experience become so emotionally consuming that any attempt at analysis breaks up the experience itself and the report is thus falsified.

The second source rests upon the attempt to interpret religious confessions and testimonies. Many intimate recitals have been published at various times by individuals who were going through religious trials and triumphs. These confessions and testimonies give the psychologist a very large amount of information about the mental life of the religious enthusiast. Similar to these confessions are the autobiographies of saints and religious workers. Many of the autobiographies are valuable sources of information about religious experiences and they have been faithfully examined much to the enrichment of the psychology of religion. To this same general method belongs the interpretation of certain literary productions such as the Songs of Solomon and the Psalms of David. Here again we enter into the very heart of religious experiences.

A third source of information makes use of questionnaires sent out to a large number of individuals. These questionnaires consist of pertinent questions about the religious experiences of an individual. The answers are subjected to appropriate statistical treatment.

Conversion.—The results of investigations directed toward the "religious mind" are still incomplete and preliminary to the main problem. One of the more common experiences to be investigated is that of conversion and upon this event many of the recent studies have been made. A number of interesting facts have appeared. The term "conversion" refers to a complex experience and includes a large number of events just preceding, accompanying, and immediately following a sudden change in the character, habits, and ways of thinking of an individual. The psychologist is not morbidly interested in the question as to why or how this sudden change is brought about; but he does want to know what conditions obtain in the nervous system when such profound alterations of experience and of behavior take place.

Age of Conversion.—It appears from the experiments that conversion is distinctly an adolescent phenomenon. Conversions begin to occur in increasing numbers at seven or eight years of age. The number grows slowly up to ten or eleven and then very rapidly up to sixteen. A rapid decline appears toward the twenties and after a more gradual decline, the experience becomes rare. If conversion has not taken place before the thirtieth year the chances are that the event will never take place. There is an important sex difference to be noticed. In general the time of conversion is earlier among girls than among boys.

Several reasons have been given to explain the fact that most conversions fall within the years ten to twenty. It has been suggested that the child is impressionable. Moreover, the increase in the number of conversions appears simultaneously with rapid changes in mental life incident to adolescence. The fewer conversions after thirty would lead one to suppose that conversion depends upon mental and nervous plasticity and that later in life the habits of individuals become too well set to admit of any sudden and profound change in their reaction systems. In other words, there seems "to be a normal period somewhere between the innocence of childhood and the fixed habits of maturity, while the person is yet impressionable and has already a capacity for spiritual insight, when conversions most frequently occur."

Conversion takes place early in life because of certain physiological conditions which obtain during adolescence. It is well known that adolescence is a period of rapid physiological transformation. Conversions fall, then, during the period of most rapid physiological growth. It is for this reason, perhaps, that conversion is said to be largely a matter of the emotions. It is not altogether improbable that the physiological storm and stress of adolescence is a good soil for the growth of the intense feelings and emotions which are characteristic of all religion.

Phases of the Conversion Phenomenon.—The experience of conversion is divided into three parts: (*a*) the preliminary period, or the period of conviction; (*b*) the central period, or the period of conflict; and (*c*) the final period, or the period of ecstasy. Let us describe them in order.[1]

The first period is taken up with the motives which lead to the sudden change of thought and of habit. These motives usually spring out of the memories, fears, or forebodings of an individual, but they are sometimes initiated by perceptions. The eternal loss in death, the fear of God's punishment, and the fear of waking up in hell, are typical motives falling in one group. Other individuals desire the approval of their neighbors and especially of dead relatives or friends. Still others are moved by altruistic motives. They desire to exercise a good influence over friends or to serve God and society. Moral ideals, inner convictions, the necessity of obeying divine impulses, remorse for sin, becoming oppressed by the idea of total depravity, responding to the teaching of a mother or a minister, and yielding to the urging and coaxing of friends are some of the many motives that seem to initiate a period of profound conflict. Most of the motives are subjective in nature and the fear of hell is as potent as any in bringing about religious troubles. These motives are frequently augmented in intensity by associative processes and they issue in the experience making up the more distressing and powerful phases of conviction. Frequent among the experiences are depression and sadness, self-distrust and helplessness, and a profound sense of estrangement from God. Restlessness and anxiety finally run into profounder depressions and a painful accusing sense of estrangement. All of these experiences are related to the feeling of an overpowering burden of sin. Conversion is frequently an attempt to escape from sin rather than an attempt to achieve righteousness. It has been suggested that the deeply-rooted emotional experiences of conviction rest upon instinctive tendencies. Feelings seem to play a larger part in the religious life of women than of men.

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[1] Read Starbuck, E. D., *The Psychology of Religion*, 1915.

The Moment of Change.—The second period is the actual period of conversion or of change. During a short interval, sometimes incredibly short, an individual may pass from the most disrupting emotions of despair to experiences so uplifting and releasing as to give considerable warrant to the common belief that conversion depends essentially upon an act of divine intervention. As a rule, the actual experience of passing from under a load of distress, of a sense of sin, of impending doom in everlasting hell-fire, to a light-hearted realization that all is right with God, is the most emotional period man may ever experience. Although there are many cases where the transition from the "old" to the "new" individual may be described as a "quiet and calm acceptance of Christ's power to save," nevertheless, tumultuous emotional upheavals are far more frequent, especially when taking place during or immediately subsequent to revival services. The experiences of conviction usually bring an individual to the last degree of dejection, humility, confusion, and uncertainty; and these may give way, in a moment's time, to joy, lightness of heart, clarified vision, exaltation, a sense of free activity, and of harmony with God.

Just what occurs at the actual point of transition is hardly known as yet. Many individuals state that the giving up of their "personal will" is essential to the experience. At any rate, the conflict is frequently resolved during an actual yielding or surrendering of oneself to a power that is believed to be great enough to effect the desired change in one's way of living and thinking. Less often a direct verbal cry for forgiveness accompanied by a belief in the fact of forgiveness seems to stand at the point of transition.

The Period of Ecstasy.—The third period consists of the ecstatic feelings that issue from the climax and the sudden change in spirit. This period may last only a few hours or it may persist for months and it is characterized by affective dispositions just opposite in nature to those falling in the period of conviction. One of the principal feelings is the sense of a new personality, a new ego that is lifted entirely above the interests of the old personality. There is a unique sense of newness in which even ordinary objects may put on new meaning and bear new significance. Such experiences as joy, bodily lightness, weeping, peace, happiness, and relief indicate the character of the post-crisis period.

Other Types of Conversion.—Most people have a little difficulty understanding the significance of conversion because they fail to take conversion for what it is, viz., one type among the many types of change which may take place in the mental life and in the reaction systems of an individual. We do not ordinarily speak of the change from infancy to adulthood as a conversion because the putting away of childish things goes on so slowly. There is a very real sense, however, in which such growth is conversion for it means everything that conversion means except the profound emotionalism of the latter. Of the many other types of change which may take place in the behavior patterns or movement systems of an individual is that which is called "alteration of personality" (see p. 373). Alteration of personality means that it is possible for the nervous system to become organized into two or more great reaction systems, and when the one is in the other must be out or when the other is in the one must be out. We shall find also, in posthypnotic suggestion (see p. 534), a way in which a genuine conversion may be wrought since under such suggestion, the behavior and mental life of an individual may be not only completely but permanently changed.

In thinking about conversions of the religious type many persons lose sight of the fact that the change in mental life which accompanies the experience is not necessarily a permanent change. As a matter of fact, the churches have recognized this fact for they have always made it a point to see that the new convert had plenty of opportunity to exercise his new faith. Without this exercise he almost inevitably became a backslider. We have to deal here, of course, with an application to religious life of one of the commonest laws of learning, viz., the law of exercise.

Worship.—We have space to consider only one of the many problems touching upon worship, viz., the problem of the use of symbols in church ceremonies. God, of course, is not seen. He must be represented in some way before the worshiper. He must somehow be symbolized during the act of worship. It appears that people differ widely from one another in this need for symbolization. There are many for whom the need is scarcely perceptible. That personal attitude or that conviction which means, "God exists!" is enough to warrant acts of worship on the part of some. A few persons find God symbolized in Nature. The man who falls upon his knees before a sunset or before a mother's love is worshiping. Most men most of the time pass by such events as they pass by any natural event, but a few see God. A great many persons, however, must have their belief strengthened by the continual presence of symbols. Statuary, paintings, sacred objects such as candles, altars, and the like, have been objects most preferred in the history of religion.

It is probably not by chance that most religions are divided within themselves upon the matter of worship. In the Christian religion, for example, we find the Catholic Church laying prodigious importance upon the formal symbols of religion, not because the symbols themselves are worshiped but because they have been found to be trustworthy means of exciting and maintaining the faith of the members. God takes up His abode in the Catholic Church. The Protestant Churches, on the contrary, place less faith in symbols. Moreover, they are not abodes of Deity; they are simply "meeting-houses." The Protestant service means a direct, collective attitudinizing toward Deity. This difference in types of worship rests, perhaps, upon a distinct difference in the intellectual and emotional attitudes of men.

Mysticism.—Mysticism has caused much comment and much study; but there is little solid fact about it. This is true not because men have failed to take the problem seriously but because the experience is so absorbing and so unique that it does not admit readily of examination and description. The saint reports that, during a period of ineffable ecstasy, he can and does come into direct personal contact with Divinity from whom he obtains knowledge for which there is no other proof than the assertion "I know." The task of the psychologist in the field of mysticism is not destruction but description. He is in search of facts and not of grounds upon which to deny the authority of religious convictions. This point is stressed because the earnest and critical study of religious experience has been hindered by men who misunderstand the attitude of psychology and of science.

James said that mystical experiences bear four distinctive marks. (*a*) They are ineffable. They must be directly experienced; they cannot be imparted to others in any convincing manner. In this respect mysticism is like the feelings. There is no way to warm up to them save by having the experience. (*b*) Mystical states have also a *noetic* quality. The saint gets knowledge; he dips into "states of truth unplumbed by the discursive intellect. They are illuminations, revelations, full of significance and importance, all inarticulate though they remain, and as a rule they carry with them a curious sense of authority for aftertime."[1] (*c*) Mystical states are transient. Consciousness is enriched; the flower blooms; then it fades away. (*d*) Mystical states are absorbing. The state immerses the individual. The mystic "feels as if his own will were in abeyance, and indeed as if he were grasped and held by a superior power."

There are a number of other facts which come out of the mystical state. At the outset and during the experience, objects, maxims, and ideas take on new and rich meanings. "Single words, and conjunctions of words, effects of light on land and sea, odors and musical sounds, all bring it when the mind is tuned aright. Most of us can remember the strangely moving power of passages in certain poems read when we were young, irrational doorways as they were through which the mystery of fact, the wildness and the pang of life, stole into our hearts and thrilled them. The words have now perhaps become mere polished surfaces for us; but lyric poetry and music are alive and significant only in proportion as they fetch these vague vistas of a life continuous with our own, beckoning and inviting, yet ever eluding our pursuit. We are alive or dead to the eternal inner message of the arts according as we have kept or lost this mystical susceptibility."[2]

It is clear from hundreds of authentic descriptions that the mystical experience is replete with memorial and affective processes. In this respect the state approaches the trance and there is no little evidence that it has parallels in the states of mind induced by drugs. Chloroform, for example, led to the following experience: "After the choking and stifling had passed away I seemed at first in a state of utter blankness; then came flashes of intense light, alternating with blackness, and with a keen vision of what was going on in the room around me, but no sensation of touch. I thought that I was near death, when suddenly my soul became aware of God, who was manifestly dealing with me, handling me, so to speak; in an intense personal present reality I felt him streaming in like light upon me. . . . I cannot describe the ecstasy I felt. Then, as I gradually awoke from the influence of the anæsthetics, the old sense of my relation to the world began to turn, the new sense of my relation to God began to fade." [1]

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[1] James, W., *Varieties of Religious Experience*, 1915, pp. 380–381.

[2] *Ibid.*, p. 383.

Mystical states may be brought on by fasting; they appear more readily under fatigue; they may be induced by ether, alcohol, nitrous oxide, and the like. The converts of many religions (Hindus, Buddhists, Mohammedans, and Christians) make it a special art to cultivate the state. The Yoga system in India is based upon special exercises and control of "diet, posture, breathing, intellectual concentration," and other forms of mental discipline. In the history of Christian mysticism, prayer, a way of concentrating on ideal things, has most often been resorted to. Such manuals as Saint Ignatius' Spiritual Exercises recommend the disciple to expel sensation by a series of efforts to imagine holy scenes.

Psychology, Religious Authority, and the Existence of Deity.—The complaint is often made against the psychologist that he seems to take particular delight in describing what he has been able to find out about religion, for he knows that many of the facts contradict the formal teachings of the theologians. It seems hardly necessary to draw up a defense against this accusation. It is worth while remarking, however, that the psychologist's defense is the defense of science in general. So long as a man is honest, and men of science have proven themselves honest through the centuries, so long as a man is careful, and men of science have proven themselves careful, so long as men search for knowledge, and this they have done with natural piety, just so long is it unprofitable to accuse any scientist of willfully destroying a sacred belief.

Beginners in psychology go astray on the psychology of religion in the same sense that students at the time of Galileo went astray in astronomy. Galileo showed that the motions of the stars could be understood without making it necessary to call in Deity at every moment to take up the petty task of keeping them out of the way of one another. The solution of that old conflict was that a self-sufficient universe obeying the principles of mechanics was just as strong a testimony for a Creator as a universe which had to be driven like a pair of horses. There was torment of soul, no doubt, before the youth of that day found themselves religiously, but today, as of old, the heavens "declare the glory of God" to our complete satisfaction, even though the astronomer can predict the return of Halley's comet toward the end of the present century.

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[1] James, W., *The Varieties of Religious Experience*, p. 391. The student should not fail to read the whole of this distinguished book.

The psychologist is interested in human behavior whether it is an isolated reaction to a disturbing fly or a total attitude toward his God. He is interested in conversion as a period during which the whole habit system of an individual may undergo a profound change. He hopes to describe as many of the conditions of this change as he can. Were he to be successful and describe them *all* he might help himself a long way toward introducing the kingdom of heaven upon earth. What would it mean if he should? That there is no God? That religion has no authority in a scientific age? Perhaps after a little soul torment we shall also see that a human being declares the glory of God not because he alone amidst nature has to be prodded this way and that, helped here and hindered there, but because he represents natural law and orderly behavior in its most creative moments.

PART FOUR

THE PSYCHOLOGY OF THE UNUSUAL AND OF THE ABNORMAL

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CHAPTER XII

NORMAL AND ABNORMAL VARIATIONS IN INTELLIGENCE

Introduction.—Living creatures differ from one another in intelligence. This seems almost too commonplace to say. All of the lower animals are less intelligent than the average man. Lower animals are less intelligent than higher animals. Infants are less intelligent than their parents. And, as we have seen, one may pass along an ascending scale of talent, either from the lowest animals to man or from the infant to man. All of these variations of intelligence, these ascending or progressive variations, have been studied under genetic psychology.

But there are variations in talent which appear even after development has run its full course. In no sense of the word does growth lead to a standardized product. First we find the so-called normal variations, the normal individual differences between members of an otherwise homogeneous group. Men, for example, after having attained maturity, differ from one another in their sharpness of vision or hearing, in their steadfastness of attention, in their quickness at learning, in their ability to control their emotions, in their powers of thinking, in short, in every moment of their intellectual life. There are ten-talent men, five-talent men, and one-talent men. And the parable of the talents holds true not only of amount of intellect but of kind as well. A man may have ten talents of motor skill and thus become a world famous pianist; but he does not thereby become a world famous philosopher.

All too often the variations in intelligence between members of the human family assume more than normal proportions. There are, first, striking differences in particular moments of mental life which assume abnormal proportions. Secondly, the difference may express itself broadly as a difference in total intelligence.

Recent statistical methods in psychology illustrate to best advantage the extent to which intelligence is a variable quantity. From these methods we may derive not only a proof of variability but also a numerical equivalent of what approximately we mean by normal and abnormal. If measurements are taken of the accomplishment of a very large number of individuals, and if these measurements are properly tabulated, it will be discovered that the persons we have chosen may be distributed into what is called a normal distribution curve. One part of the curve will represent a few individuals of low achievement, a second part will show many individuals of moderate achievement, and a third part will reveal a small number of exceptional achievement. In the accompanying table, for example, the percentages reveal the way in which individuals are distributed under various degrees of ability in certain directions. Average intelligence is by far the most frequent and the relative number decreases in a definite manner as one passes to intellects of higher ability or to intellects of lower ability.

TABLE III

CLASSIFICATION OF DEGREES OF "BRIGHTNESS"[1]

Class	*Percentage of all Children Included*
"Near" genius or genius	0.25
Very superior	6.75
Superior	13.00
Normal, or average	60.00
Dull, rarely feeble-minded	13.00
Borderline, sometimes dull, often feeble-minded	6.00
Feeble-minded	1.00
Moron	.75
Imbecile	.19
Idiot	.06

Now the measurements we take may be of accomplishment in single talents or of the hypothetical thing called general intelligence. In getting an idea of general intelligence, samples of various kinds of ability are taken, they are then given a numerical value, an average is struck and this average is said to be a measure of general intelligence. If we take a sufficient number of samples from a given intellect and find that each sample falls at or about the same level of excellence we may conclude that the person we are evaluating is an average or typical person. Another person, however, may yield some samples falling far above or below the majority of the samples. Such an intellect represents one kind of deviation from the normal. As we examine a third person we may discover that most if not all the samples fall *materially* above or below the average. This is a second sort of deviation from the normal. That is to say, the last two assays are obviously of "abnormal" intellects or intellects that deviate widely from the average, the first in single traits, the second in general endowment.

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[1] From Woodrow, H., *Brightness and Dullness in Children*, 1919, p. 54.

Just how far an intellect may deviate from the norm before it will be called abnormal is a question that is open to discussion but which need not detain us here. The principle of deviation is clear. If a person falls materially below the average, he is a deficient or subnormal person and if he falls materially above the average he is superior or supernormal. Let us give illustrations.

Illustrations.—While traveling in Germany Coleridge came, at Göttingen, upon a strange story which he has set down as follows: "A young woman of four or five and twenty, who could neither write nor read, was seized with a nervous fever, during which, according to the statements of all the priests and monks of the neighborhood, she became possessed, and, as it appeared, by a very learned devil. She continued incessantly talking Latin, Greek, and Hebrew, in very pompous tones and with most distinct enunciation. . . . The case had attracted the particular attention of a young physician, and by his statement many eminent physiologists and psychologists had visited the town. . . . Sheets full of her ravings were taken down from her own mouth, and were found to consist of sentences, coherent and intelligible each for itself, but with little or no connection with each other. Of the Hebrew, a small portion only could be traced to the Bible; the remainder seemed to be in Rabbinical dialect. All trick or conspiracy was out of the question. Not only had the young woman ever been a harmless, simple creature, but she was evidently laboring under a nervous fever. . . . The young physician determined to trace her past life step by step. . . . He, at length, succeeded in discovering the place where her parents had lived . . . and that the patient had been charitably taken by an old Protestant pastor at nine years . . . and had remained with him for some years. . . . Anxious enquiries were then, of course, made concerning the pastor's habits; and the solution of the phenomena was soon obtained. For it appeared it had been the old man's custom for years to walk up and down a passage of his house into which the kitchen-door opened, and to read to himself with a loud voice out of his favorite books. . . . Among the books were found a collection of Rabbinical writings, together with several of the Greek and Latin fathers; and the physician succeeded in identifying so many passages with those taken down at the young woman's bedside, that no doubt could remain in any rational mind concerning the true origin of the impressions made in her nervous system." [1]

In this interesting manner Coleridge has recited the story of a mind which was capable, apparently, of a very superior kind of performance. In a moment of delirium this person had repeated phrases the meaning of which she did not know. Moreover, the conditions for recall had been laid down in her nervous system in a wholly fortuitous manner.

Let us set against this illustration one that reveals a wholly different condition. L. R., a white boy of doubtful parentage, went to school for the first time when he was seven years of age. From the outset his progress was slow. At the end of the year he was barely capable of continuing into the next grade. When put under examination it was found that he could not carry out many of the simple school and test problems easily encompassed by fellows of the same chronological age. He was unable, for example, to repeat correctly four digits; he could with difficulty count to twelve; he was unable to copy accurately even simple geometrical forms; he found it impossible to repeat a sentence of ten syllables until the sentence had been given him five times. And at fifteen years of age L. R. was still having trouble in performing the same kind of tasks.

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[1] Coleridge, *Biographia Literaria*, 1847, Vol. I, pp. 234–235.

An individual who can hear the reading of a foreign language by another person, who can hold the impressions thus gained over a long period of time, and who can finally reproduce what she has heard so completely as our illustration shows, possesses a talent for learning which stands upon an entirely different level of excellency than is the case with normal subjects. A person, on the other hand, so sluggishly and inadequately equipped as our second illustration indicates, likewise differs from the common run, but in the opposite direction.

As a matter of fact these deviations take us so far from the normal that they almost suggest diseased conditions of the nervous system. We thus are led to a third group of deviations, viz., those which do definitely owe their origin and course to diseased or disordered nervous systems.

We thus have three problems before us, viz., (*a*) the determination and description of normal variations in intelligence, or the psychology of individual differences, (*b*) the determination and description of superior and inferior types of intelligence, and (*c*) the determination and description of types of nervous disease. The first two problems which have to do with *quantitative* deviations from the normal are discussed in this chapter. The third type, which includes *qualitative* deviations from the normal, will be considered in the next chapter.

THE PSYCHOLOGY OF INDIVIDUAL DIFFERENCES

The attempts of experimental psychology to state the facts of individual differences in intelligence and thus to lay a foundation for applied psychology (see p. 483), stand upon an entirely different level than those we have just reviewed. The initial steps in this program were taken by W. Stern in the book

Ueber Psychologie der individuellen Differenzen, a book which presented not only the program of differential psychology but which went a long way toward listing the differences which were then known to obtain between individuals. Stern's book was not an accumulation of anecdotes and of occult practices, but a respectable foundation for a Psychotechnology of the future. Since his time an untold number of experimental studies have been made in the field, and it is now our task to indicate the scope and the general nature of these studies. A list of the known differences between individuals would fill more pages than this book contains. We mean to illustrate the problem and define the field of research.

Major Types of Individual Differences in Talent.—We say that individuals differ from one another in intelligence. Intelligence, as we have found, can be described in terms of its several moments or phases. Intelligence is a judgment we form of an individual's ability to make differential reactions to qualitative and quantitative changes in the environment, to make precise reactions to prepotent parts of the environment, to enjoy change and improvement of ability under practice, to make suitable alterations in the energy of response, *i.e.,* to adapt bodily energies to the needs of the occasion, to divine and prepare for the future, to insert productive delays between stimulus and response, and to react to situations in highly organized and characteristic ways. Men differ from one another in each of these moments of intelligence. We may measure the extent of their talents either by gaining their intelligence quotient or by listing each of their talents in turn. These differences are probably initiated by hereditary factors and either accentuated or modified by training.

The differences which are of concern to psychology and to psychotechnology arise at the following points. There are differences in the visual discrimination of sizes, distances, extents, and colors, differences in auditory discrimination of pitch, tonal fusions, consonance and dissonance, and musical intervals, and variations of a parallel sort in all of the other sense-departments. Individuals differ from one another in their capacity to judge weight, the rate and extent of movement, and of rhythm. There are wide differences in the ability of persons to judge intervals of time. There are differences in the conditions under which objects and events may become prepotent to individuals, that is, there are differences in attention in all of its various aspects, there are differences in memory and learning ability with respect to the kind of material most readily learned, the time needful for learning, the rate of forgetting, the physiological limit of learning, and so on. Attempts have been made to search out the correlations between fast learning and fast or slow forgetting, or slow learning and fast or slow forgetting. There are differences in reaction time, the historically famous difference between the sensory and the motor type being a reflection of this phase of research. There are differences in emotional stability, differences in the readiness with which persons can solve problems and draw inferences, differences in the way or the path they habitually follow in solving problems, and finally, there are notable differences in the total patterning of a person's life, differences which go by the name of personality and character.

Since the psychology of individual differences arises primarily in conjunction with psychotechnological problems, we shall not undertake any survey here of the mathematical extent to which these differences obtain. We shall meet some of these figures in the chapters that follow as we describe psychotechnology in its various phases. In the meantime we can mention types of differences such as sex differences or race differences, and we shall also indicate the problems that fall under the phrase "psychological types."

Age Differences.—Age differences can be treated briefly. If we regard the intellect of the child with respect to the intellect of the typical adult instead of regarding it genetically, all of the facts in our chapter on the mental life of the child would fall here. That is to say, the infant is a problem to differential psychology as well as to genetic psychology for his perceptual ability, memory ability, and other capacities are distinct deviations from the adult "norm."

The mental life of the senescent, however, has not been adequately described. As a matter of fact, only the grossest generalizations have been made about it and about the possible deterioration which old age brings. The failure of the end-organs to maintain the resiliency of youth affects seriously the perceptual functions and the ability to execute bodily movements. It is probable that the daily life of the senescent is controlled more largely by memories and long-established habits and skills than are the lives of younger persons. It is also probable that selfhood and all other types of organization in mental life and behavior are more stable than in the earlier years. As we have seen, conversion, *i.e.*, *change*, is a rare phenomenon among the old. The deterioration of the body probably lessens the readiness with which new neural patterns and organizations can complete themselves. We often hear of "second childhood," of the failure of memory in old age and the like; but the character of mental life during senescence has led to far more speculation than fact and this paragraph of a general psychology must wait for completion upon adequate experimental knowlledge.[1]

Racial Differences.—Exact differences in intellect attributable to differences in racial stock are almost as poorly known as are the differences conditioned by old age. It is said that in Europe there must be a fundamental racial difference between the Græco-Latins and the Teutons. The Greeks, Romans, Italians, and Spaniards are "talkative, quick and vivacious" in their actions, while the Germans, English, Dutch, and Scandinavians are "taciturn and deliberative."

Unfortunately, this is a question that rarely escapes racial jealousies and antagonisms. The only method that has been available in experimental studies is the method of administering "mental tests" and racial inferiority or superiority has often varied with the racial affiliation of the individual constructing and administering the tests. Inferences drawn from the degree of civilization attained by various racial stocks are faulty, for "civilization" is an obscure thing to define in degrees, and its fluctuations have been too frequent to make it a standard against which mental life can be measured.

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[1] See, however, the suggestive comments of G. S. Hall in *Senescence*.

From studies already completed, it appears that racial differences have been greatly overestimated. The original "mental tests" were often tests of cultural or educational acquirement rather than of ability to achieve; but as standards of measurement have been improved the opinion has grown that alleged racial differences are, more often than not, differences due to cultural levels or differences in social heritage. Those mental functions which can most easily be submitted to experimental investigation, the elementary acts of perception, attention, memory, and feeling show rather insignificant racial differences. The visual reactions, the memory span, and the reaction time of an American, a German, a Russian, a Chinaman, and a Hottentot are all about the same. These measurements are not, of course, measurements of what is commonly called "general intelligence"; but the further one gets from social and cultural factors the more obvious it becomes that original human nature is much the same all over the world. If there are any large racial differences, they will be discovered, preferably, among the higher intellectual capacities.

Sex Differences.—The belief a dozen years ago in large and rather significant sex differences and the current belief that most of these alleged differences are the result of social traditions show how easily inadequate measures of mental ability may go wrong. For a good many years studies have been directed toward the respective abilities of the sexes and a very large part of the early studies seemed to demonstrate important sex differences. Just what the differences meant, however, was a debated question. In some quarters they were taken as a sign of a very material difference in the general mental abilities of the sexes, the male invariably predominating over the female.

We shall give a few samples of the differences that have been found. Comparisons made on the basis of school grades, the Binet-Simon tests, and questions of general information have frequently placed girls ahead of boys; but male interpreters have hastened to explain that such results are due to greater docility and industry among girls and to the fact that girls mature earlier. Some studies show that females have a finer spatial threshold on the skin, better color vision, and more rapid motor responses to changing perceptions; but males are superior to females in the discrimination of weights and visual areas. The evidence for sex differences in pitch discrimination are contradictory. With respect to general motor ability it is supposed (*a*) that girls develop faster than boys from infancy; (*b*) that boys are superior to girls in rapidity of movement under conditions in which the direction of attention remains fixed as in reaction time and tapping; (*c*) that girls are superior to boys in rapidity of motion in types of activity in which the direction of attention is constantly shifting, *i.e.*, in activities that involve rapid adaptations.

Sex differences are often expressed as in the following table. The percentages mean that the designated proportion of men reach or exceed the average or the median of the women.[1]

TABLE IV

	Per Cent
Reaction time	68
Tapping	81
Sorting cards (speed)	14
Sorting cards (accuracy)	44
Thrusting at a target	60
Drawing lines	72
Threshold of pain	46
Threshold of taste	34
Threshold of smell	43
Lifting weight	66
2-Point discrimination	18
Memory	32
Ingenuity	63

Females are superior to males in memory ability and especially in rote memory at all ages. There is, however, a faster rate of improvement with drill among boys than among girls.

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[1] See Starch, D., *Educational Psychology*, 1927, p. 74.

It is said that the "tendency to be 'on guard' against embarrassment is characteristic of the female sex," a tendency which is set forward to explain the fact that free associations appear more readily in the male while females are better in practiced systems of associations. Tests making use of time and space, logical arrangement of themes, mechanical puzzles, and arithmetical problems have given males a better rating. There is some evidence of greater emotional disturbances among women and they are found to have more and greater dislikes than men. In the desire to be like others, girls choose personal acquaintances oftener and boys choose public and historical characters. Girls choose their ideals from the opposite sex many times oftener than boys. Boys excel in perspective drawing and girls in decorative drawing.

Other studies, some on specific and some on gross mind-body capacities, give the following results. Here again the figures mean that a given proportion of men equal or exceed the median or average woman.[1]

TABLE V

	Per Cent
Color naming and card sorting	24
Cancellation tests	33
Spelling	33
English (school marks)	35
Foreign languages (school marks)	40
Immediate memory	42
Sensory threshold	43
Retentiveness	47
Association (speed and accuracy)	48
General information	50
Mathematics (school marks)	50
School marks (average of all studies)	50
Discrimination (other than color)	51
Range of sensitivity	52
History (school marks)	55
Ingenuity (special tests)	63
Accuracy of movement (of arm)	66
Physics and chemistry (school marks)	68
Reaction time	70
Speed of movement (finger and arm)	71

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[1] See Starch, D., *Educational Psychology*, 1927, Chap. V., and Thorndike, E. L., *Educational Psychology*, vol. 3.

What Do Sex Differences Mean?—These are a very few differences drawn from a large number of studies. As we have suggested, however, the important problem has to do with the interpretation put upon such facts. Are the differences we have mentioned peculiarly sex differences or can differences of the same kind and degree be found frequently among the individuals of the same sex? Do the differences we have set down or other differences of the same order bear upon the question of the relative mental ability of the sexes? The opinion is gradually growing that the first question should be answered affirmatively and the second in the negative. In other words, it is now quite generally believed that many of the differences are due to cultural and social conditions and not to any inherent differences in the sexes. There must be, of course, some differences directly dependent upon sex. The different physiological functions of the female and the different relation she holds to the social group must imply some differences on the side of intellect; but these differences do not relate, apparently, to high or low mental ability. They are differences due to the exigencies of the primary sex functions and to related functions. The male and the female come from the germ plasm, and while the principle of sex-linkage seems to imply a certain amount of difference, it must not be nearly so great as has long been supposed. In short, the differences between the sexes, like differences between races, are qualitative differences in single moments of intellectual life. It remains to be seen whether these differences mean an actual quantitative difference in intelligence. It is clear that if intelligence means capability in a *man's world*, women may be less intelligent. The issue is doubtful, however, if intelligence is defined with respect to a *natural world*.

Psychological Types.—All of the differences which we have considered up to this point are differences in single traits and in part-traits. And all of them are useful to know, as we shall see when we consider their relation to problems of education, medicine, commerce, and industry. But in addition to these differences in single traits there are unique and important differences in what we may call attitudes and dispositions. As we have already seen (p. 30) the organism meets the environment not only with specific muscular patterns but with attitudes, prevailing dispositions, as well.

Historical Notes.—These differences in attitude or disposition have had a long history. One of the oldest classifications of individuals with respect to their various abilities had to do with the affective life. It was Aristotle who divided temperaments into four kinds. The sanguine temperament, for example, came out of the amount and the circulation of the blood. The lymphatic individual gained his affective attitudes from the flow of lymph, the choleric from the flow of yellow bile, and the melancholic from the flow of black bile. Many variations have been introduced into this affective scheme. Individuals differ, no doubt, in the kinds of mood which they allow to persist over long periods of time. Aristotle's classification, however, is more important historically than factually. In view of the fact that these moody and temperamental attitudes play a large part in industry and in medicine it has become necessary to search out more dependable information in this field.

The first step in what was hailed as a science of psychological types was taken by Galton; but it has never been shown that the differences which he described mean anything either to psychology or to psychotechnology. Galton was one of the first to obtain by careful means an account of the way individuals varied in their use of images. His interest had been excited by reading certain anecdotes in which it was alleged that a few persons possessed visual memories so clear and sharp as to be easily confused with perceptions. During his study he discovered that imagery might vary in clearness and in quality from one individual to another in a manner wholly unsuspected up to that time. Some individuals he found to possess no visual imagery whatsoever, while others used such processes regularly in all of their mental operations. A few were found whose imagery was so clear as actually to cause confusion in certain kinds of performance.

Galton's initial studies on visual imagery have since been supplanted by other studies of greater scope and offering keener description. They show that individuals fall into four classes with respect to the type of imagery most frequently employed. The visual type uses visual imagery, the auditory type uses auditory imagery, the verbal-kinæsthetic type uses kinæsthetic processes conditioned by the throat and by the general bodily set, and the mixed type uses imaginal processes appropriate to the object recalled. It was thought for a time that artists must be visually-minded and musicians auditorily-minded; but it appears that mental processes are vicarious in their operation. That is to say, any process whatsoever may contribute to the development of meanings.

Inferior and Superior Intelligence

The quantitative deviations go, as we have stated, in two directions, viz., toward more and toward less. That is to say, one can say that the phrases superior and deficient intellects have definite mathematical meanings. In either case, mental life may deviate from the normal in single respects or it may present a wholesale departure from our established norm. We shall speak, first, of persons who are deficient in certain isolated talents or part-talents. The intellects which fall here are the best known of those that depart from the typical.

Specific Deficiencies.—There are individuals who cannot react to the reds and greens. We call them color-blind. Where the normal person sees greens and reds in various degrees of saturation the color-blind person sees grays of different brightness value. Many of the departures from the normal are of this kind. Total blindness deprives an individual of a whole segment of what would otherwise belong to his effective environment. Such a person is obliged to compensate for the loss of vision by an increased use of some of his other talents. The study of this process of compensation in the blind has added an interesting chapter to psychology. Similar studies on persons born deaf and upon persons who have acquired deafness show

how other talents come to carry the burden of intellectual life.

There are similar failures in each of the sense-departments. An individual who cannot respond to olfactory stimulation is called anosmic. Under certain conditions whole areas of the body or a whole arm or limb may fail to respond adequately to temperature stimulation or to pressure and pain (anæsthesia, analgesia, etc). In still other cases, the sensitivity of the internal structures of the body may be lessened.

Helen Keller and Laura Bridgman are the most illustrious cases of individuals who were otherwise normal but who were distinctly abnormal in the sense of the above paragraph. There are also many other blind and deaf who, in other respects, are normal; but as a rule abnormality of this type is accompanied by other failures. This is particularly true of single deficiencies in attention, or memory, or thinking. Moreover, these specific abnormalities are usually associated with pathological or functional disturbances and they belong, therefore, to the next chapter.

General Deficiencies.—The second type of quantitative deficiency is not in single traits but in whole groups of traits, in the whole intellectual fiber of the individual. Intellects of this sort have been classified into the following three groups: (*a*) the *idiots*, or those individuals whose intellectual development does not exceed that of a two-year-old child; (*b*) the *imbeciles* or those whose mental development surpasses that of the idiot but is less than that of a child about seven years old; and (*c*) the *morons* or those whose mental development is above that of an imbecile but does not exceed that of a child of about twelve years.

Idiocy, the lowest form of mental enfeeblement, results from some defect or disease of the brain which is often congenital but which may be acquired during early stages of growth, either in the embryo or after birth. Different kinds of idiocy have been named; but the basis of distinction is so inadequate that most classifications are without any great psychological value. The description of the mental life of the idiot is, also, quite inadequate; only the barest outlines can be given. On the side of isolated talents the idiot is frequently deficient. Between seven and eight per cent of idiots are blind; and in other subjects there may be such ocular defects as farsightedness, color blindness, strabismus, cataract, and involuntary eye movements. The auditory reactions are also disturbed in a variety of ways. Taste and smell perversions are frequent and many individuals are quite unresponsive to the cutaneous and subcutaneous excitations.

The muscular movements of the idiot are striking. Although a few may remain wholly inert, the majority are in constant motion, the movements being quite rhythmic and automatic in character. Idiots, in a sitting position, frequently sway or oscillate backward and forward or from side to side. Other impulsive or automatic movements are made to resemble dancing and running. The idiot is quite incapable of any sort of refined motor coördination. Many do not even learn to walk and among those who do, the movements are irregular and retarded. The most characteristic abnormality of the idiot is his inability to attend. In the lowest types of idiocy even primary attention is dulled. On account of the deficiency in perception and the sluggishness with which prepotencies are established (attention and interest), skills are acquired only under great difficulties. All of the higher performances stand at a very low level of development. Their presence at all may even be questioned.

The *imbecile* represents a little higher order of mental development. The single talents are apt to be more normal, motor coördinations stand at a higher level, and there is a general increase in all of the more complex mind-body performances.

A typical case of such feeble-mindedness follows. Abbie was small, left-handed, and awkward. She always put the same foot forward when going up stairs. She knew letters but could not read; she could count to ten; she knew some colors and forms, sang a few hymns learned at home. She had normal sight and hearing, was fond of play, but had a bad memory, and poor power of imitation. She was gluttonous, untidy, untruthful, shy, and profane.

Three months after admission to the hospital she could read "A man ran" and "I see a man," thread a needle, sew buttons, count to twenty, and do very simple additions such as

$$\begin{array}{ccccc} 1 & & 1 & & 3 \\ 1 & & 2 & & 1 \\ \cline{1-1}\cline{3-3}\cline{5-5} \end{array}$$

After ten years in school she was still small; but she could make a bed, and iron an apron. She could not count the cost of three one-cent stamps and three two-cent stamps with the stamps before her, nor repeat five figures or a sentence with fifteen words. She was able to write about twenty-five words from memory; she knew the days of the week but not the months of the year. She did not know how many fingers she had on both hands.[1]

The *moron* stands still higher in the scale of development. As a matter of fact, the better class of morons often pass among social groups without being detected. Their perceptual talents are, for the most part, complete; and the other single talents are of average quality.

The principal difference between the moron and a person of average ability lies in the rather dull character of judgment and thinking. It is only under more crucial conditions that a reliable distinction can be drawn between intellects of normal attainment and intellects that stand midway between the normal and the moron. A recent description of such a case reveals some of the mental differences which fall in this part of our own task.[2] K, the individual described, entered a large Western University with credentials showing graduation from a small but accredited high school. The records revealed that he had spent five years in securing fifteen units and that he was twenty years of age. His first year's work in the University went poorly. He was put under observation and it was found, by using a variety of mental tests, that his "mental age" was about twelve and a half years. There was nothing in his general behavior to suggest this result. He was well dressed, possessed excellent manners, and had entered a Greek letter fraternity. His father was a banker, a proprietor of a general store, and his mother was, apparently, a superior woman. After K was dismissed from the University he was frank to admit that he was glad for "he never could learn books anyway."

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[1] See Woodrow, H., *Brightness and Dullness in Children*, 1919, pp. 9–11.

[2] Terman, L. M., "Adventures in Stupidity," *Sci. Mo.*, 1922, Vol. 14, pp. 24–40.

"K is in fact only moderately less dull than the average of the genus homo, judging from the intelligence scores made by nearly two million soldiers. His intelligence is probably not equalled or exceeded by more than 70 per cent of our white voters, by more than 50 to 60 per cent of semi-skilled laborers, by more than 40 or 50 per cent of barbers or teamsters, or by more than 20 to 30 per cent of unskilled laborers. It is probably not equalled or exceeded by more than 30 to 40 per cent of our South Italian or by more than 20 to 30 per cent of our Mexican immigrants. . . . Among the Jukes, Kallikaks, Pineys, or Hill Folk, he would represent the aristocracy of intellect."

K's intellectual inferiority certainly did not consist in deficient sensory, perceptual, or motor processes. He was a good athlete, a good penman, and a good automobile driver. But in tests of memory ability his inferiority began to appear. His memory span was short, and he was unable to reproduce correctly simple geometrical designs. To imagine or think out new combinations of forms or of objects lay beyond him. He lacked resourcefulness and ingenuity, he was unable to pick out or to explain the simplest kind of absurdities. His lack of intellectual resources appeared in his deficient associative bonds. He was unable to find words of the same or of analogous meaning or to pick out essential likenesses and differences. That is to say, K was equipped to get along very nicely with his perceptual world but he lacked the abilities that depend upon intellectual initiative, planning, range and flexibility of association, and the ability to formulate and to use concepts.

Superior Capacities.—The description of intelligences standing on the lower side of normality is always depressing and we can, therefore, turn with a feeling of relief to intellects above the average, that is, to the super-normal minds. First, we shall consider persons that are superior in one or more single traits and then we shall turn to persons of general superiority.

This part of the field of psychology is probably as full of exaggerated stories as any other part. Even some of the performances that are set down in scientific literature seem as incredible as any that are described by uncritical persons. Men who can repeat, word for word, the Bible; individuals who can read several pages once and then repeat them accurately; musicians who can hear a complicated score and then rewrite it, are examples of intellectual superiority in the class we are now describing. The familiar cases of Seneca, who is said to have repeated the exact order of 2,000 disconnected words which he had heard spoken but once, of Cyrus and Cæsar who, at one time, are alleged to have known the names of all the soldiers in their respective armies, and of Themistocles who could address by name 21,000 Athenians, are historical illustrations of unusual performance in a single ability.

Technically, persons who excel in a single capacity are called *idiots savants*. "These aptitudes are usually in the direction of music, mathematics, the mechanical arts, building, woodcarving, drawing, painting, memory for facts or dates, playing games (chess, checkers), and of a low order of wit or drollery." [1]

Persons having superior or freakish mathematical ability have been described at length. One of the earliest of the rapid calculators about whom reliable information is available was Tom Fuller, the Virginia Calculator (1710–1790). Tom Fuller came from Africa as a slave when he was about fourteen years old, but his fame as a calculator did not spread until he was about seventy. At that time he is known to have reduced a year and a half to seconds in about two minutes, and seventy years, seventeen days, twelve hours to seconds in about a minute and a half, correcting the result of his examiner, who had failed to take account of the leap years. Save for these unusual mathematical feats Tom Fuller was quite illiterate. One of the greatest of the calculators was Johann Martin Zacharias Dase (1824–1861). His public school education began at two and a half years but did not continue long, for, although he appears to have been a marvelous calculating machine, he was quite unable to understand the principles of mathematics and had limited ability in other fields. Dase was able to multiply together mentally two eight-figure numbers in fifty-four seconds, two twenty-figure numbers in six minutes, two forty-figure numbers in forty minutes, and two one hundred-figure numbers in eight and three-quarters hours. He abstracted the square root of a one hundred-figure number in fifty-two minutes. All of these computations save that of the one hundred-figure number are much more rapid than those of a good computer using paper. All of Dase's shorter computations were exceedingly rapid and his memory for numbers put him in a class by himself.[1]

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[1] See Church and Peterson, *Nervous and Mental Diseases*, 1921 (9th ed.), p. 884. See also *Pop. Sci. Mo.*, 1896 (December), for an article on *idiots savants*.

In many cases freakish mathematical ability depends upon heredity. The mother or the father may have special mathematical ability or a great capacity to remember. The ability appears very early. "Gauss began his calculations before he was three years old; the present writer, at four; Ampère, between three and five; Whately, at five; Pugliese and Succaro, at about five; Colburn, at five; Safford, at six or earlier; Mathieu de Coq, Mr. Van R. of Utica, Bidder, Prolongeau, and Inaudi, at six; Mondeux, at seven; the Countess of Mansfield's daughter, at eight or earlier; Ferrol, Mangiamele, Grandmange, and Pierini at early ages not definitely stated."[2] In prodigies of this kind and especially among "arithmetical" prodigies general mental talent is at a low level. The calculator may hardly be able to go through the grades.

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[1] See Mitchell, F. D., "Mathematical Prodigies," *Amer. J. of Psychol.*, 1907, Vol. 18, 61–143.

[2] *Ibid.*, p. 96.

The capacity to do prodigious arithmetical problems depends, first of all, upon a good memory. It is known that some calculators know a multiplication table up to the hundred-thousands. But even without such a table, memory for rapid multiplications of a smaller order would tide the calculator through a long computation.

No final explanation of this freakish sort of intellectual talent has been forthcoming. It has been discovered, it is true, that the lightning calculator may use vivid visual imagery in his operations. The figures may appear to arrange themselves upon a blackboard or upon a piece of paper in his "mind's eye," and the result writes itself out. More often, however, the answer comes verbally and without any relevant processes preceding it in consciousness. There is absolutely no reason to believe that prodigies use new kinds of mental processes or unique types of neural functioning. Their performances are due to exaggerated abilities which in a less extreme form belong to us all.

The Genius.—The study of the genius is complicated by the vague circumstances under which he appears. Although superior men have been born in all stages of written history and although they have exerted a powerful influence upon the world's history, yet they are an enigma, even to themselves. Men spring into leadership in art or science or politics or war and win the admiration of their fellows without furnishing in their own lives any conclusive evidence of the means by which their success is achieved. They set out on a level of their own and appear to owe little to help and example. They may issue from the lowliest parentage or from the highest; their offspring may fall back to the old level.

Genius and Insanity.—The problem has been further complicated by the fact that many men of genius were also men of unsound, even of insane, intellect. This relation between genius and insanity was recognized by the earliest writers. Aristotle alleged that, under the influence of congestion of the head, "many persons become poets, prophets, and sibyls, and like Marcus the Syracusan, are pretty good poets while they are maniacal, but when cured can no longer write verse." In the *Phædo*, Plato says that "delirium is by no means an evil, but, on the contrary, when it comes by the gift of the gods, a very great benefit. In delirium the prophetess of Delphi and Dodona performed a thousand services for the citizens of Greece; while in cold blood they were of little use, or rather of none. It often happened that, when the gods afflicted men with fatal epidemics, a sacred delirium took possession of some mortal, and inspired him with a remedy for those misfortunes. Another kind of delirium, that inspired by the Muses, when a simple and pure soul is excited to glorify with poetry the deeds of heroes, serves for the instruction of future generations."

Among men of letters alleged to have been actually insane or to have had hallucinations and other idiosyncrasies characteristic of mental aberration are Swift, Johnson, Cowper, Southey, Byron, Goldsmith, Charles Lamb, Poe, Pascal, and Rousseau. Swift, for example, suffered at various times from deafness, giddiness, impaired sight, muscular twitchings, and paralysis of muscles on the right side of the mouth. He was even known at one time as the "mad Parson" and was haunted with a dread of losing his mind. His condition became worse in old age and before his death it is said that he approached a state of imbecility. Nervous and mental vagaries have been described in the families of Shakespeare, Milton, Macaulay, Brontë, Dickens, Thackeray, Balzac, Dumas, Hugo, Bach, Handel, Mozart, Beethoven, Mendelssohn, Donizetti, Schumann, Napoleon, Carlyle, Newton, Bunyan, Fox, and many others.

The wholesale manner in which very eminent men and women have been subjected to the insinuations of those interested in mental disease suggests that the matter must have been somewhere overdone. It is possible that our very inadequate description and conception of insanity is partially to blame for the confusion between superior ability and insanity. For a long time insanity has been described and thought of as almost any unusual kind of performance, and it is small wonder that a man who has lived ahead of his time, or who has sacrificed himself, by long continued absorption in one topic, to science and away from social obligations, should be thought strange or even insane. There is no doubt that many eminent men have had dubious nervous and mental experiences. There may be, it is true, something about the operations of a creative mind that keeps it on the front edge of stability; but the facts are, as yet, obscure.

Precocious Children.—There are many descriptions and notices of precocious children who have, at the chronological age of eight or ten years, the mental age of fourteen or sixteen or even twenty. Robert Wiener, for example, graduated from Tufts College at the age of thirteen years; at seventeen he took the degree of Ph.D. at Harvard and then studied for two years at Cambridge University, England. At nineteen he was appointed assistant professor of philosophy at Harvard College. Winifred Stoner falls in the same class. At six months she could talk and knew colors. At sixteen months she could read and at two years she began keeping a diary. At three she acquired the use of the typewriter and was soon writing stories and jingles for newspapers. At five she spoke eight languages and at seven she knew the outlines of Greek, Roman, and Scandinavian mythology. At twelve she was ready for graduate work in any university in the country.[1]

In many cases like the above the marks of genius appear during childhood but as the person matures he returns to a more normal level. It looks as though such types of genius in childhood owed their origin to factors which accelerate intellectual development during infancy and childhood but which lose their efficacy as the child grows older. This is not always the case, however. Tasso enjoyed a certain amount of fame at eight,

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[1] Groszmann, M. P. E., *The Exceptional Child*, 1917, pp. 106ff.

Southey wrote dramas before he was eight, Mozart took piano lessons at three, played minuets and composed short pieces at four, and gave a public recital at five. It is said that Bacon, Kant, Locke, Berkeley, Descartes, Spinoza, and Macaulay were about as precocious. Macaulay read widely at three and at seven he began a Compendium of Universal History.[1]

Experimental Studies on Genius.—A record of notable progress and anecdotes about the idiosyncrasies of the intellectually great is not to be confused with an experimental and critical study of great mentality. Such studies are being undertaken, the largest of which has led to the collection (Terman) in the schools of California of over a thousand pupils who have an intelligence quotient of over 140. It is not assumed that all of these children will become famous, but it is hoped that over a period of years some of the factors contributing to intellectual greatness will appear.[2]

Explanations of Precocity.—It will not do to say that genius is closely related to insanity because so many great men have been insane. Just as many great men have been normal. Moreover, if insanity were intimately related to genius, we might expect that our hospitals for the insane could become centers of art, literature, philosophy, and science. There was no greater suggestion of pathological conditions among the children selected for Terman's study than one would expect in any group.

Hall was an active advocate of what has been called a *prolonged adolescence* theory of genius.[3] Adolescence, as the reader will recall, is a period free from the conventions, repressions, formalities, and traditions of maturity. The genius is more like the adolescent than like the typical adult. He is unconventional, impulsive, imaginative, daring, ready to try the new and forsake the old. It is held that the average age of first distinct success is significant for this theory. Lancaster has shown that 100 actors won their first great success at an average age of 18 years, 50 poets at 18 years, 50 artists at 17 years, and 100 scientists at 19 years. There are, on the contrary, men like Kant or William James who did not find themselves until relatively late in life.

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[1] Woodrow, H., *Brightness and Dullness in Children*, 1919, Chap. 1.

[2] Terman, L. M., *Genetic Studies in Genius*, 1925.

[3] Lancaster, E. G., *Ped. Sem.*, 1897, Vol. 5, 61–128.

Whatever special theory may be advanced, whether insanity, or a prolongation of adolescence, or special native endowment, the following factors must be accepted as having an essential part to play in great intellectual achievement. The first is undoubtedly the fund of factual knowledge upon which the genius can draw. The statement that genius consists mostly of hard work emphasizes this fact. There is nothing mysterious about a person who can produce new things because he has a greater amount of material with which to work. In the second place, the mind of the genius is supplied with a rich associative background out of which relevant materials can be quickly selected and irrelevant materials thrown aside. The ease with which associative tendencies can be reëstablished depends, of course, upon unknown conditions in the nervous system. At any rate, the ability to make a selection from a very large stock of information is not an indication of magic. In the third place, the genius is not a plodder. That is to say, he can and does jump rapidly from one idea to another. It is as if a student, working through the theorems of a geometry, came to a place where he could solve an "original" problem without having to recall his axioms part by part. Somehow, the nervous system provides short-cuts; and on the side of mental life the individual appears to secure results for which there were no specific antecedents. Finally, the mental life of the genius may include a great many mental attitudes or dispositions which are packed with the particular significances of a great many facts. We speak of men who have "a mind" for music. We mean that they have worked with music for so many years that they live in a "musical world." They think in musical terms. It is not strange, then, that they should, now and again, produce something in the way of music that the rest of mankind had not thought of. There are also known to be distinct attitudes commonly called "mental attitudes" in which a brief flash of mental life seems to carry the significance of a very complex situation. There is in this field abundant opportunity for research.

CHAPTER XIII

DISORDERS AND "DISEASES" OF MENTAL LIFE AND OF BEHAVIOR

Introduction.—One of the darkest periods in the record of man's attempts to understand the world and his fellows consists of his failure to appreciate the real nature and significance of "mental ailments" or "diseases of mind." Not until a little over a hundred years ago when Philippe Pinel, risking his life at the hands of the leaders of the revolution, cut the shackles from the insane in the Bicêtre, did any material change take place in the manner of thinking about aberrations of intellect or in the methods of treating them. Up to the time of Pinel, the maniac, possessed, so it was alleged, by demons, spent his wretched days chained to a wall or confined in a narrow cell. To break the monotony of his existence the attending physicians were wont either to administer drugs freely or to resort to the then common practice of bloodletting.

Primitive Explanations of "Mental Disease."—The distressing history of disorders of intelligence is one of the results of the uncritical and superstitious beliefs to which primitive man was subject. Nothing appeared more simple or more rational to him, so we discover, than to believe in occult powers or forces which were striving for or against his comfort. The afflictions of his body were mysterious enough, but "mental afflictions" must have been strange indeed. As a matter of fact, primitive records reveal a long history of the worst kind of superstition and even cruelty in the case of the ailments of the intellect.

In our description of the origin of religion we have already seen why it was that the many coincidences in nature which primitive man could not account for, and his inability to cope, without outside aid, against the malicious influences residing in objects about him, easily led him into the habit of attributing mental ailments to the operation of these unkind powers and forces. As the notion of animism developed, forces or powers became spirits, and most of our recent history of medicine includes beliefs about the evil spirits residing in the body. The simplicity of the belief and the naïve way in which it was accepted are illustrated by the story from one of the early church worthies who related that a nun, having eaten some lettuce without making the sign of the cross, swallowed a devil, and that, when commanded by a holy man to come forth, the devil replied: "How am I to blame? I was sitting on the lettuce, and this woman, not having made the sign of the cross, ate me along with it."

The General Problem.—The notion is now definitely established that the mentally deranged and the mentally sick are to be described and understood in terms of the concepts that have come from a study of normal mental life and behavior. Their afflictions are usually understood as verbal and manual reaction systems that have become distorted, that are depleted or augmented, that have become perverted. The individual, for example, who hears bells ringing when there are no bells and who reacts to these bells as though the population were rejoicing over his coronation as King of the Medes and Persians, is not discovering any new kind of knowledge or employing any new knowledge-getting talents. Memories such as are common to all auditorily minded persons have merely become heightened in clearness; they are mistaken as meaning the sound of real bells. The associative tendencies that bring along with bells the ideas of a celebration and of personal honor are certainly not unique in kind. The normal person, however, recognizes his memories as memories, his hopes as hopes, his desire for higher place as a desire. But the abnormal person is not able to check this one experience against the rest of his experiences; his convictions have become perverted, his associative tendencies have gone wrong, and we speak of him, therefore, as suffering from a mental ailment. Aberrant mental life or behavior represents, then, a qualitative deviation from a hypothetical normal; but it is not a deviation that brings into psychology any new reaction systems or types of mental organization. The first need of the mental pathologist in psychology is a sound knowledge of normal mental life.[1]

Facts from Nature's Laboratory.—To some persons, the intellects we are about to describe are interesting because they are unusual or because they furnish amusement. As was suggested in the last chapter many persons pay money to see the least oddity in nature. They even judge sciences by their traffic with Mars or with ghosts or with "Elixirs of Life" or with mental prodigies or with unusual forms of energy. But to science the abnormal is interesting and valuable for its own sake. A diseased tree, an odd rock, or abnormal behavior is to be described and explained along with the rest of the world. But any deviation from the normal possesses further value for it always "leads to a better understanding of a thing's significance to consider its perversions and its exaggerations, its equivalents and substitutes and nearest relatives."

In a certain sense the wide deviations of which we speak are examples of experimental method in the large where nature is the experimenter and where the appearance of unusual mental functions and of diseased minds marks the subjects upon which nature has experimented. It is in this respect that a psychology of the abnormal is of significance to the psychology of the normal intellect, for often it is only under unusual and strange conditions that even the normal can be adequately understood. Nature has, apparently, performed experiments upon the nervous system and upon the composition and organization of mental life that are entirely beyond the ability and means of the neurologist or the psychologist. It is impossible for the neurologist artificially to induce tumors or to excise portions of the brain as he sees fit in the laboratory, but he can and does take advantage of just such conditions when they appear in ordinary life processes. In a similar way, the psychologist cannot artificially induce phobias and psychasthenias and dual personalities at his pleasure, but he can make the most of them when they appear in the hospitals and psychopathic clinics.

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[1] Consult Rosanoff, A. J., *Manual of Psychiatry*, (6th ed.), 1927.

Unusual conditions, then, isolate special factors in mental life, enabling us to inspect them unmasked by their more usual surroundings. Furthermore, abnormal conditions may suggest problems to normal psychology that would otherwise pass unnoticed. The psychopathologist and the psychotherapist turn to normal psychology for an understanding of what to expect from a normal or typical person; for they are aided thereby in coming to an understanding of the significance of the abnormal symptoms and conditions with which they have to deal. The description of a normal mind, on the other hand, also has profited, for many of the facts of the normal have been obtained only by taking account of the ways in which minds may go wrong or suffer from disease.

Neuroses and Psychoses.—The title of this section might also run: Is there such a thing as "mental disease"? We do not ask this question in order to see just how "mental stuff" can be diseased, or how a soul can suffer injury, pass through a period of healing, and become well again, although perchance still bearing the scar of the injury. We ask the question in order to make it plain that men are not agreed as to what shall be attributed to the nervous system and what to mental life itself. If the doctrine of psychophysical parallelism (p. 133) is valid it must be that every mental failure mirrors nervous failure or that many nervous failures mirror mental failures. A psychosis, however, is said to be a genuine mental disturbance without necessary neural accompaniment. A neurosis, on the other hand, is a neural disturbance which may or may not be accompanied by a mental disturbance. In other words, at the very beginning of abnormal psychology, we come against the mind-body problem, not in a new, but in a very troublesome form. The reader is asked to keep this problem in mind through the following chapters, even though he will not find a possible solution until he reaches Chapter XVII.

Definition of Terms.—Many of the afflictions to which intellects are subject fall under the general term "insanity." No one, apparently, has been able to give an adequate definition of this term, and the feeling is beginning to grow that it cannot be defined any more than can virtue or justice or patriotism. It is a word designed to cover a very large number of more specific ailments, but it has a social rather than a scientific connotation. The statement that insanity "is a diseased state of mind in which there is more or less persistent departure from the normal manner of thinking, acting, and feeling" reveals how vague a term the word is and how much its meaning is relative to other kinds of mental performance. We shall probably proceed to just as good advantage, at least, if we lay aside the word "insanity" and describe, under other terms, some of the typical kinds of deviation which often appear.

Before we do this we must get acquainted with some of the words in the vocabulary frequently employed to describe aberrant or diseased minds. Two of these words, viz., illusion and hallucination will be discussed later. The illusion, we shall say, is an inadequate perception. An hallucination is a perception experienced in the absence of the physical object. A *delusion* has been described as a false belief or conviction. The individual who insists, for example, that he has no feet, and persists in his belief in spite of all contrary evidence, is possessed of a delusion or of a false belief. The inability to accept evidence, or the inability to widen one's understanding by establishing associative bonds, or employing relevant imagery, is a characteristic trait of many aberrant intellects.

Delusions may be either systematized or unsystematized. In the former case, the false belief consists of parts bearing a logical or coherent relation to one another. A person who insists that he is Julius Cæsar and who continues to believe so, his delusion going along with behavior entirely consistent with the part, is suffering from a systematized delusion. The person who is experiencing an unsystematized delusion, however, shows no signs of coherence in speech or behavior. In delirium, for example, the false beliefs are fragmentary, fleeting sequences, with few relations to one another.

Delusions are also expansive or depressive. An expansive delusion embodies the attitude of grandeur, beauty, perfection, power, wealth, or anything else that exalts or uplifts the patient. A depressive illusion, on the contrary, serves to impress the patient with his own insignificance or his unworthiness. Such belittlement leads to the assumption that he is being persecuted, that he is in poverty, that he is morally untrustworthy, that there is something essentially wrong with his body, and the like.

"Confusion" is a term that is loosely used in describing behavior conditions, but in general it appears to refer to a kind of lapse in the associative bonds and determining tendencies that hold verbal and manual skills together. Attitudes and behavior patterns get jumbled, ideas and words appear and run their unrelated courses as if a dam had broken and released a flood of water. If the confusion is of low order, that is, if the waters from the dam run at a low level, the confusion is known as stupor. The psychophysical capacities are suspended in stupor. Dementia refers to suspended mind-body activities of a little different sort. Stupor does not mean that mental life has degenerated but dementia is essentially a term implying degeneration. The intellectual talents actually dwindle away, they retrogress to previous levels, they disintegrate.

Classification of Mental Diseases

The bedside description of disturbances of intellect is no more a description of a disease than is the bedside account of a somatic disturbance. A high fever, a slow or fast pulse, high or low blood pressure, the color of the eyes, of the face, or of the tongue, and any other symptoms are not the disease. They are bodily changes which the disease has brought about. In the same way disturbances of mental organization, delusions, fancies, loss of memory, and the like are not mental disease; they are symptomatic of some sort of organic irregularity which creates the symptoms. A bedside description of symptoms, therefore, is not apt to render an account of classes of disease that will be scientifically valuable. Only the obvious things are set down in the notebook and it often happens that the things seen *are seen* because the diagnostician has some notion in advance as to the cause of the trouble. For these reasons there is practically no experimental psychology of disturbances of the intellect. There are a great many clinical pictures of what happens to people under different circumstances and there are a great many case histories; but genuine experimental studies for the advancement of knowledge rather than for the advancement of professional reputation could almost be numbered upon one's fingers.

It ought to be possible to classify or to group diseases of mental life under the several moments of intelligence, that is, as disorders of perception, of attention, of learning and memory, of emotion, of imagination and thinking, and of self or personality. In a very general way this can be done; but the reader must remember that intelligence is not something made up of these seven parts as if the parts were independent and self-consistent talents or aptitudes. The sickness is of the person, not of any single phase or aspect or organ of the person; and this must be remembered when it seems that any single group of symptoms could be placed equally well in two or more of the sections which follow. As we have said before, the discussion of the intellect in terms of its moments is only a pedagogical device, for at heart it is the organism that is being studied. And by describing mental ailments in this way we merely say that there are some symptom-groups in which perceptual functions are most prominent, others in which emotional factors are most important, and so on.[1]

Disorders of Perception.—Under syphilis, tuberculosis, malaria, pellagra, rheumatic fever, alcohol, morphine, cocaine, autointoxication (disorders of metabolism), diabetes, and the like, the chief symptoms of mental disturbance are aberrant perceptions. Delirium is "preceded by restlessness; sleep is disturbed; the patient is dull; he does not comprehend easily, nor can his attention be readily held. Very soon excitement makes its appearance and may increase, usually with the rise of temperature and the development of the other symptoms of the infection. Illusions make their appearance. The patient mistakes the objects in his room, the figures upon the wall-paper, the persons about him. Instead of the furniture, animals, phantastic forms, and figures are seen. The nurse, the mother, or other relatives, as the case may be, become strangers or strange beings. Sounds are equally misinterpreted; the voices of friends, footfalls, the opening and shutting of doors, noises in the street, all give rise to illusions, as is more or less evidenced by the patient's manner and the phrases that escape him. Tactile illusions, illusions of taste and smell, appear also to be present; the patient misunderstands the attempts at handling him, and fails to recognize the drink or food that is offered. . . . The hallucinations rapidly become numerous and diversified; soon they play the leading rôle, and the delusions which the patient manifests are correspondingly varied, changeable, and fleeting. Quite commonly the delusions are frightening, painful, distressing. Houses are on fire, people are being killed, children are being tortured, battles are being fought, the patient is compelled to fight for his life; dismembered bodies and other frightful visions terrify him." In more intense fevers the delirium is "furious in character, the patient raves, shouts, sings; his features express in rapid sequence fright, anger, terror, anguish, ecstasy. He struggles, tries to escape or to hide, he weeps, shrieks, or may, for brief intervals, laugh or smile." [1]

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[1] Read Conklin, E. S., *Principles of Abnormal Psychology*, 1927; McDougall, W., *Outline of Abnormal Psychology*, 1926.

In *confusion* the perceptual functions are dulled. The patient fails to recognize his room, the bed, and other objects about him. There is not so much mistaken identity, *i.e.*, illusion and hallucination, as there is inability to identify. Objects fail to attract his attention. In contrast to delirium where there is so much hurry and excitement and rapid flow of associations, the confused mind is sluggish, obscured, and dream-like.

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[1] Dercum, F. X., *A Clinical Manual of Mental Diseases*, pp. 37ff.

Stupor brings a still greater cessation, not only of perception but of all the intellectual talents. The experience is often preceded by confusion or even by delirium. Gradually the confusions become deeper and deeper and the inability to apprehend his surroundings increases to such an extent that the patient lies motionless and indifferent. No objects can arouse him; his emotions are dulled; he does not speak; and other motor capacities are in abeyance.

Disorders of Skill.—A patient may, for example, begin to dress early in the morning but fail to complete the task before noon, for every piece put on may come off a dozen times before the patient can decide that it is properly adjusted. Another patient may count the number of steps it takes to enter a given room and then suffer intensely because he is not sure of the number. Other individuals suffer from the lack of certain inhibitions which throw into their speech or into their performances some constantly recurring word or movement. A conversation, for example, may be interrupted over and over again by a word thrown in without meaning or significance. The muscular movements are impulsive, quick jerks known as "tics." Still another sort of "fatigue psychosis" is sometimes called aboulia or lack of "will power." The individual knows that a given act is to be performed but he is unable to set himself going. Frequently the effort to force a movement results in distress, pallor, and palpitation. Aboulia may assume a great many forms such as inability to speak, to write, to pass through a certain door, to perform even such simple acts as rising from a chair.

Aboulia, then, is the name for a state of extreme incapability to throw any of the acquired habits or skills into action. Even if a skill or a habit is initiated the action may be completed only with the greatest slowness and unsteadiness.

Echolalia is a name used to distinguish certain automatic verbal movements such as the ceaseless repetition of the words which those about are using. Other movements are also repeated just as unendingly. It is as if the patient had been transformed into an automaton and was incapable of initiating any acts of skill on his own account.

Then there are all kinds of impulsive movements and a multitude of curious mannerisms which belong to this phase of intellectual breakdown. Patients will suddenly throw objects or break out laughing or walk a few paces back and forth for hours at a time. There are also impulsive jerkings of different muscle groups or there are postures which are maintained long beyond the normal limit of fatigue of healthy persons.

Disorders of Memory.—In addition to the pathological failure of memories which are due to inadequate perceptual experiences during deliria or hypnosis there are several forms of distinct failure to recall objects and events which have an ordinary expectation of recall. This failure is known as amnesia.

There are amnesias of almost every conceivable variety. Pathological forgetfulness is partial when it concerns one class of objects or events, *e.g.*, forgetfulness for special branches of knowledge, a specific foreign language, proper names, and the like. When all types of objects and events are concerned the amnesia is said to be general.

It is commonly reported in the newspapers that a person has been found wandering about the streets without any memories of his previous home or condition and without any knowledge as to his whereabouts. Sometimes these amnesias last for a few weeks or they may last for years. Sometimes they are for single periods of time and then again they may hold true of the interval just before the blow on the head or the delirium that produced the amnesia. In all of these cases the amnesia is not complete in the sense that every vestige of training is lost. Most of the patients can still speak or write, and they may walk naturally and execute other fundamental habits as in normal life. In other respects, however, the amnesia may be complete.

Disorders of Attention.—Attention means that, because of conditions either external or internal to the organism, some objects or events become prepotent over others in determining behavior. There is, moreover, a certain orderliness in the way in which series of objects or events become and remain prepotent. A disorder of attention would be due, therefore, to a disruption of the conditions which govern prepotency. Let us give some examples.

The "fixed idea" is a type of abnormality in which some single object, event, or belief becomes and remains prepotent over longer or shorter periods of time. It is as if an idea could become parasitic, attach its suckers to the body of "mental life" and abide there indefinitely. A "monomaniac" is a man of a single idea. In his case, the normal conditions of facilitation and inhibition have broken down and only one neuronal system or one group of systems comes to intellectual fruition.

The phrase "flight of ideas" represents a contrasting condition. A patient suffering from such a condition was asked about the death of his mother. His answers were: "The poor woman came home from her work in the evening. She was taken with a chill. . . ." One of the assistants picks up a pencil from the table in front of the patient. "Hold on! there is a pencil, a blue pencil. . . . Can you draw?" Another assistant begins to cough. "If you have a cough you should take Geraudel's tablets. . . . You know spitting on the floor is prohibited. . . . That's a fact. . . ." The first assistant unbuttons his coat. "I hope you are not going to undress here; that would be improper! . . ." Noticing a small rent in the vest of the same assistant: "I guess you have no wife to do your mending! . . ."[1] The experimental conditions (*i.e.*, the question) which, in a normal patient would have led to a connected account of the death of the mother have here broken down. It has become impossible in this patient for the question to remain prepotent in determining the course of verbal response.

This breakdown in the conditions of prepotency affects also the flow of memory. In this case the psychiatrist of the old school speaks of a strict "flight of ideas." Objective evidence of this ailment is found in an incessant patter where there is no sign that "normal" associative tendencies are directing the patient.

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[1] Rosanoff, A. J., *op. cit.*, p. 42.

Disorders of Thinking.—In the delay that sometimes occurs between stimulus and response, the pattern of response may be profoundly modified by determining tendencies, by problem-bearing tendencies and by the many verbal and manual skills of an individual so that the final behavior issues, not with respect to the stimulus as such, but with respect to the problem which the situation may have raised. The individual thus gets himself out of a difficulty or creates a new reaction pattern, either manual or verbal. This is the way we have described thinking. On the side of mental life, thinking means that those memories are brought to the solution of a problem that are, to some extent at least, relevant to the problem. It is clear, of course, that irrelevancy may be a common thing. If it becomes too common or too persistent we may speak of a disorder of thinking. Irrelevant ideas and idea-systems (as revealed in the speech and behavior of the patient) appear in almost every type of mental disorder since, after all, it is the person, not the talent, who is sick; but there is one mental disease, however, which gives a very systematic change in thinking. *Paranoia* is a name given to a group of symptoms prominent among which is a series of orderly and arranged but false judgments and convictions with respect to which the patient orders his life. The disease has a number of forms which are named after the particular type of perverse rationalizing which may dominate the syndrome.

In one form "an individual who has previously attracted attention as being odd or eccentric, or who has been observed to be morbidly reserved, reticent, and peculiar, perhaps suspicious and unsociable, enters upon a period of depression and hypochondriases. He begins to suffer from various obscure visceral sensations. These appear at first to be but slightly pronounced; they may be vague, faint, or only occasional in occurrence. Later they may become more insistent, unpleasant, and distressing. The patient refers them to the head, the body, the genitals. There are fullness or emptiness of the head, sensations of pressure or constriction, headache, buzzing in the ears, distress in the præcordia, palpitation, unpleasant, painful, or strange sensations in the stomach or bowels, or it may be throbbing or other queer feelings in the genitals." [1] These experiences are always hallucinatory and being morbid the patient keeps them to himself. Shortly he begins to speculate about them and in many cases he seeks causes for them outside of himself. The conviction begins to form that they have been imposed upon him. He gets sensitive about them and shortly begins to find in every trivial incident a relation to himself. He becomes impressed with the belief that people are watching him, talking about him, disliking him, and finally the idea grows that he is being persecuted. Other illusions, visual and auditory, appear and serve to strengthen his false belief that he is an object of derision if not of animosity. He may believe a conspiracy has been set against him, that people have planned to harm him; his home is wired or full of speaking tubes, there are hidden telephones and other devices to pry upon him. Now and then among his illusions he may recognize a voice or a face and one individual comes to represent in his mind the evil forces working against him. At the height of his idea of being persecuted, he may complain to his friends or write letters to the authorities, the police, or the mayor. When the patient has settled upon some one person or persons as being his enemy, he may assault the person. The high state of organization into which the false ideas may enter is shown by the cunning the patient exercises in assaulting the author of all his ills. He is so enamored with the idea of persecution that after the death of his "persecutor" he does not hide but freely tells of his torment and of the need of avenging himself.

Religious Paranoia.—In another form of paranoia the patient ascribes his ills to his own wickedness or to the fact that he has committed some great crime. In this case the paranoia is apt to take what is called the mystical form, for the patient may believe that his sufferings have been sent to him by divine will. The expansive form of paranoia is another sign of the degree to which ideational life may go wrong and yet remain highly organized in error. The patient may deduce from his persecution that he must be a distinguished man or that he is of royal or of God-like descent. The delusion of being a prophet or the Messiah, a great discoverer and inventor, a great social reformer, and the like, have been common in history, literature, and religion. The state of mind called paranoia may run its course for many years; but ordinarily it passes sooner or later into a period of mental deterioration.

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[1] Dercum, *op. cit.*, pp. 144ff.

Perverse Emotions and Moods.—"Melancholia may be defined as a form of insanity in which the essential and characteristic feature is a depressed and painful emotional state, more or less persistent, and pursuing, other things equal, a wave-like course." [1] After a period of nervousness, depression, and worry the patient falls into a state of profound dejection. His attitude, his facial expressions, and his words betray "sorrow, grief, despair, hopelessness." He remains quiet, listless, drooping, tearful. Illusions may appear in which the patient believes that he is mentally and morally useless. The "delusion of the unpardonable sin" with its woes is an example of the experience of melancholia. Life comes to hold nothing for the patient and suicide may follow.

Mania is an emotional perversion in the opposite direction. Instead of depression there is elation. The maniacal patient is boastful and buoyant. Strangers are greeted as old friends; there is a constant flow of words in the most animated spirit. Associative bonds are reëstablished with great facility and the patient leaps on from exaltation to exaltation without order or arrangement.

Circular insanity is a form of derangement comprised of both melancholia and mania. That is to say, a patient may oscillate back and forth between profound dejection and high elation.

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[1] Dercum, *op. cit.*, p. 64.

The cycle may be completed only once in a lifetime; but just as often the patient changes several times, each cycle being very similar to the others.

Alterations of Personality.—The self is "*a* mind, the mental phenomena correlated with a particular nervous system, and arranged and determined in accordance with the tendencies of that system."[1] The self has been described before in these pages as the highest type of neural organization.

Now selves, *i.e.*, the totality of neural organization, go wrong. In a certain sense all of the mental diseases are examples of perverted selves; but there is one form of disturbance that is peculiarly a disease of selfhood or personality. Personality may be altered or doubled or even multiplied.

To some extent alteration of personality takes place in ordinary life. The intellectual capacities of a man in his office and related groups of traits may be completely displaced by another group belonging to the golf course or a hunting expedition. In the former he sees letters, bills, ledgers, files, desks, and the like; he thinks of sales, profits and losses, bonds, and so on. Behavior patterns are definitely bent in one direction. But while playing golf he sees golf clubs, handles them, talks golf to his fellow-players; he thinks of golf, of old scores; he imagines himself as joining the "hole-in-one" club. Here again behavior patterns are bent in one direction; but there is little in common to the two states of organization.

Alteration of personality "is effected through the primary organization by experience and later coming into dominating activity of particular unitary systems of ideas with their affects, on the one hand, and the displacement by dissociation or inhibition of other conflicting systems on the other. In slighter degrees and when transient this alteration may be regarded as a mood. When the alteration is more enduring and so marked by contrast with the preceding and normal condition as obtrusively to alter the character and behavior of the individual and his capacity for adjustment to his environment, we have a pathological condition. When the alteration is slight and affects few systems it may be easily overlooked; or when it is accompanied, as it often is, by physiological conditions, it may be so masked by them as to be mistaken for so-called neurasthenia. It is when the dissociation is so comprehensive as to deprive the individual of memory of his previous share of personality, or of certain acquired knowledge or other particular experiences, that the personality is easily recognized as a dissociated one. When the inhibiting repressing force that induces dissociation ceases to be effective, that is, when the dissociated systems come again into activity and suppress the temporarily dominant systems, then the individual returns to his normal condition (in which he may or may not remember the dissociated state) just as a person returns to his habitual character after the passing of a mood. We may speak of the two phases—the normal and the altered one—as constituting together *multiple personality*. As these two phases may continue to alternate with one another they are also alternating personalities. The second or altered state is also sometimes called a *secondary personality*. There may be several such secondary personalities which may alternate with each other or the normal personality." [1]

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[1] Titchener, E. B., *A Beginner's Psychology*, p. 309.

Alteration of personality is closely related to that condition which psychiatrists call amnesia or pathological forgetfulness. A portion of one's memories may drop completely out of consciousness or out of the possibility of recall. As we have seen, amnesia may be selective for a certain period of one's life or for all the experiences associated with a particular event in one's experience or for certain kinds of acquisition, as in the loss of memory for a language or any other educational acquisition.

Dual personality, however, means a little more than mere amnesia. It means that systems of ideas and correlative patterns of behavior take hold, as it were, of the organism and control it for ends quite foreign to those adopted by the whole personality. Not only ideas, but emotions, instincts, inherited dispositions, habits, and even physiological functions are dissociated from the other intellectual functions and control for the time being the operations of the individual.

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[1] Prince, M., *The Unconscious*, 1921, pp. 545–546.

A typical case of dual personality may be described as follows: A certain individual came to a psychopathic hospital suffering from general nervous fatigue and many of the associated ailments. Upon examination it was discovered that the patient was in a phase of multiple personality named A. Later another phase, called personality B, appeared. A had no memory for B but B had full knowledge of A. A was distinguished from B by a marked difference in mood, taste, health, emotion, preference, sentiment, points of view, habits of thought, and controlling ideas. A was, as we have said, a depressed, fatigued individual, full of doubts and scruples, while B was more exalted and completely free from the dejection and moody qualities of A. The alteration from A to B took place every few hours or days. Both A and B were but fragments, apparently, of the normal or complete personality. Under hypnosis the combined personality appeared possessing the memories of both A and B and free from the peculiar characteristics of either. The united personality C was able, after recovery, to give a description of her experience while individuals A and B. C referred to herself as living in two different states. B, however, always referred to A as "she." That is to say, there was no feeling that the self-consciousness of C and of A was identical with her own.[1]

After the recovery of this individual she wrote a letter describing her case. In the letter she says: "I remember myself perfectly as 'A' and as 'B.' I remember my thoughts, my feelings, and my points of view in each personality, and can see where they are the same and where they depart from my normal self. . . . As I have said, I have now, as 'C,' all the memories of both states (though none of the co-conscious life which, as 'B,' I claimed and believed I had). *These memories are clearly differentiated in my mind.* It would be impossible to confuse the two as the moods which governed each were so absolutely different, but it is quite another thing to make them distinct on paper. . . .

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[1] Prince, M., *The Unconscious*, 1921, Chap. XVIII.

"I am, perhaps, of a somewhat emotional nature, and have never been very strong physically though nothing of an invalid. I have always been self-controlled and not at all hysterical, as I would use the word. On the contrary, I was, I am sure, considered a very sensible woman by those who know me well, though I am not so sure what they may think of me now. I am, however, very sensitive and responsive to impressions in the sense that I am easily influenced by my environment. For instance, at the theatre I lose myself in the play and feel keenly all the emotions portrayed by the actors. *These emotions are reflected vividly in my face and manner, sometimes to the amusement of those with me and, if the scene is a painful one, it often takes me a long time to recover from the effect of it. The same is true of scenes from actual life.*

"Before this disintegration took place I had borne great responsibility and sorrow with what I think I am justified in calling fortitude, and I do not think the facts of my previous life would warrant the assumption that I was naturally unstable. . . .

"A year previous to this division of personality a long nervous strain, covering a period of four years, had culminated in the death of one very dear to me—my husband. I was, at the end of that period, in good physical health, though nervously worn, but this death occurred in such a way as to cause me a great shock, and within the six days following I lost twenty pounds in weight. . . . I was depressed, sad, felt that I had lost all that made life worth living and, indeed, I wished to die. I was very nervous, unable to eat or sleep, easily fatigued, suffered constantly from headache, to which I had always been subject, and was not able to take much exercise." [1]

It was at this time that the personality broke into the two selves A and B. The case is illuminating and also typical, because it was shown that the core of A and B had been started nearly a score of years before by groups of incompatible idea-systems which bothered C and kept her from living a well-balanced mental life.

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[1] Prince, M., *op. cit.*, pp. 557–559.

Hysteria.—Hysteria is a name for one of the commonest groups of symptoms of mental disorder and one that has figured most largely in the whole history of medicine; but it is at the same time one of the most elusive and misunderstood syndromes with which we have to deal.

A little light will be thrown upon the problem by considering further the cases of multiple personality just mentioned. These cases have been described as a division in the intellectual life of a patient, a division so complete that when one movement system is "in," the other is "out." In other words, there is a type of dissociation, a splitting asunder of what should be a well-rounded whole. But splitting asunder may also be thought of as a sort of "shattering." If we think of a personality as shattered, or as being "shatterable," we shall have at least one clew to the understanding of hysteria.

Two types of symptoms are found most often in this disorder. They are anæsthesia and suggestibility. Anæsthesia or insensitiveness appears in irregular areas over the body. A part of the skin, an irregular patch on the trunk, limbs, or head, or an entire half of the body may become insensitive. These are the "devils' spots" of the days of witchcraft. Hyperæsthesia, on the contrary, means increased sensitivity and is distributed in much the same manner as anæsthesia. The motor symptoms of hysteria manifest themselves in paralyses, tremors, muscular incoördination. There are also significant visceral or organic changes. In all of these cases, the patient behaves as though movement systems and idea groups of limited extent were easily detached from the total life of the individual, much as twigs are torn from a tree. It can be shown that the patient is anæsthetic, not because of organic trouble, but merely because he accepts the suggestions offered. This will become clearer when we consider functional diseases (p. 381).

Whatever else hysteria may be it is characterized by a high degree of suggestibility. Almost any idea will be accepted without criticism. This is a loose way of saying that a determining tendency or some other neural disposition is set off without at the same time arousing associated processes. It is now thought that many of the classical symptoms of hysteria were the result of the physician's suggestion. The leading question: "Can you feel as well with your right arm as with your left?" carries the suggestion that perhaps one can't, and there is immediately set up in the one arm or the other of the hysterical patient a state of anæsthesia or of insensibility. Hemianæsthesia applies to cases of complete insensibility on one half of the body. Sleeve anæsthesia means lack of sensibility in the whole arm. In a similar way the physician speaks of glove anæsthesia (the hand), sock anæsthesia (the foot and lower leg), and the like. Insensibility may affect any sense-department or any parts of the body.

The suggestion that a part of the body is insensitive or that it cannot be moved is often an inference drawn from a wound. During the war there were many wounds which cut, for a time, peripheral nerves in different parts of the body, and hysterical patients, observing the loss of function, continued to believe that all sensibility was gone even though the wound healed and the peripheral injury was repaired.

Neurasthenia and Psychasthenia.—Almost every book upon abnormal psychology treats somewhere of neurasthenia and of psychasthenia and yet none of the alleged "diseases of mind" present more difficulty in description or in classification. Both of the terms refer to a kind of aberration which appears when an individual has expended unusually large amounts of energy which the body is unable to replace. Under conditions of fatigue a disorder appears in which mental life may be said to be "shattered." When this condition becomes chronic, it is known as nervous prostration. While under the influence of such extreme nervous fatigue the patient is highly irritable, the muscles are weak, the reflexes abnormal, and tremors may appear. Many organic and kinæsthetic sensations referred to the various parts of the body mean extreme fatigue to the patient.

The psychasthenic person is incapable of sustained intellectual effort; secondary attention appears only under great difficulty; his affective and emotional condition is altered so that he is easily excited by irritable or oppressive objects and events. The emotion of fear is easily aroused and is accompanied by a variety of organic changes. Special fears and obsessions are characteristic of this mental ailment. Some individuals may have a strange fear to cross an open place, others are excited by small or closed places, still others by crowds. As a matter of fact, almost any object may become, for a fatigued mind, a fear-exciting object.

It appears from these descriptions that neurasthenia and psychasthenia are names for the same thing, the one referring to the nervous system, the other to mental life. It is also clear that both names apply to a condition similar to hysteria.

The Dementias.—Having come to a given level of development, deterioration may suddenly set in and reduce intellect to the level of idiocy or of imbecility. In a sense dementia means the reversal of growth. It is genetic psychology backward.

Aside from the degeneration which follows paranoia and certain other diseases, dementia præcox and senile dementia are the commonest forms of mental disintegration. Dementia præcox has been called the insanity of adolescence for it ordinarily begins between the ages of fourteen and twenty-five. The process of mental impairment is very slow so that its onset can rarely be seen. There is, however, a time when the patient is readily fatigued mentally; there may be insomnia, headache, restlessness, inability to grasp new ideas, and especially a progressive failure in the ability to organize mental life. Soon it is observed that the patient becomes slower or heavier mentally, that speech and thought are alike inhibited, disconnected, disordered. Memory may become faulty, the emotions dulled; in fact all mental operations depending upon the higher nervous centers lapse and finally the patient falls into a sort of stupor.

The perceptual functions are not greatly impaired; but the perception of objects exacts little interest; the patient is apathetic. The associative bonds deteriorate so that the succession of ideas is broken and incoherent. "The patient is often practically will-less and has lost every ordinary incentive to normal behavior. He sits stupidly about, negligent of person and dress and of the demands of nature. . . ." [1]

Other forms of dementia have been described. Senile dementia, for example, is the loss of mental powers and abilities accompanying old age. The state begins very gradually and is marked by sluggish mental operations, the slow acquisition of new modes of thinking, increasing motor incoördination and lack of precision, unusual disintegration of memory, and finally, the mental retrogression becomes so complete as to bring the individual to the mental level of a child.

THE NATURE OF MENTAL DISEASE

We have been describing symptoms and groups of symptoms (syndromes) which are commonly called "mental diseases," but we have not yet asked what is the *nature* of such diseases. An answer to this question depends upon how we shall understand in what respects the organism may suffer derangement. Four types of bodily ailment may be distinguished. There are (*a*) the *traumatic* injuries, such as broken bones, torn flesh, disrupted blood vessels, and cancerous or other virulent growths on or within the body. (*b*) There are the *toxic* disorders and diseases. All of the bodily afflictions arising directly or indirectly from the presence of microörganisms in the organs and structures of the body fall under this class of diseases. Some of them are infectious and some of them result from improper functions within the body itself. Disturbances resulting from drugs (alcohol, nicotine, strychnine, morphine, bromine, etc.) also fall under this heading. (*c*) There are the *nervous* diseases. Many of these diseases are secondary products of the ailments we have already mentioned, but some of them are peculiar to the nervous system itself. The nervous tissues, for example, may begin to waste away or degenerate as in some of the dementias.

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[1] Church, A., and Peterson, F., *Nervous and Mental Diseases*, 1921 (9th ed.), p. 814.

Some of the traumatic and toxic disorders have a special affinity for the nervous system. Alcohol and other drugs, syphilis, head injuries, and many infections are among the essential causes of nervous malfunction. Were it not for the direct influence which these diseases have upon mental life and behavior we might include them under the traumatic group. They bear so distinctly upon mental ailments, however, that it seems best to consider them apart from other disturbances. (*d*) There are the so-called *functional* diseases, commonly called the "mental diseases." In "mental" or functional diseases neither the body nor the nervous system seem to show any pathological change and neither are there any demonstrable toxic conditions. It is as if we had a delicate machine which would not run properly even though all its parts appeared to be present and in their proper place. Traumatic injuries, toxic ailments, nervous diseases, and functional diseases are, then, the general types of affliction to which the human organism is subject.

The Functional Disorders.—It will be useful and instructive to consider at great length the fundamental nature of the functional disorders, partly because this concept stands at the very center of psychological theory, partly because some of the methods of psychological healing derive their usefulness from a proper conception of what transpires in the nervous system (or in the structure and functions of the mind) under afflictions of this type, and partly because some of the ailments we have just described are functional while others are organic. We may approach the topic with a discussion of deliberate and unintentional malingering, then turn to a discussion of functional nervous diseases, and finally consider a theory of mental affliction which we owe to Sigmund Freud.[1]

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[1] Read Hart, B., *The Psychology of Insanity*, 1923; Hart, B., *Psychopathology*, 1927.

Malingering.—Malingering is a term which came greatly into vogue during the Great War. It is a term used to describe the attempts of a man to simulate the symptoms of some disease or to simulate blindness, deafness, or paralysis, in order to escape military service. Some attempts at malingering are, no doubt, deliberately and consciously planned, but we shall wholly miss the puzzling nature of the functional ailments if we fail to see that malingering may also be wholly "unconscious," *i.e.*, pursued without deliberate intent. In short, many people are sick because they *think* they are, because it has been suggested to them by persons, or by events in the environment or in their bodies. Having accepted this proposition, they act with respect to it, and so find themselves under the care of the doctor.

We shall find a suggestion of the mechanism which lies behind unintentional malingering in the state of hypnosis. We shall find in our discussion of this state that the subject will accept and act upon any suggestion which the operator gives. Earlier in the book we had occasion to refer to the organization of movement systems and to the fact that behavior patterns could, on occasion, become separated from one another and live and act on in their own right. Normal living means coördinated living, integrated living, while disintegration or dissociation means literally that the left hand may not know what the right hand doeth. Unintentional malingering may stand upon the same foundation.

Let us suppose that, being in the normal state, we think of ourselves as partially hypnotized. Let us imagine another person saying to us, "You are now blind! You cannot see the pictures upon the wall of this room!" Let us suppose further that we accept without any question, without any doubt, this assertion. We should, then, be functionally blind! Such a state of affairs sounds fantastic; but we have only to turn to the conditions under which some objects become prepotent over others, *i.e.*, to the conditions of attention, to know that objects and events may be running their courses before our open eyes and ears and yet not be apprehended by us because we are absorbed in something else. If, in absorption, or in deep attention, we may not know all that is going on about us it is possible that in successful suggestion a similar condition may be produced.

We may draw still another illustration directly from hypnosis. Let us suppose that we have told a hypnotized subject that a person seated in a chair directly in front of him will fade gradually away and finally disappear. If this suggestion is given authoritatively and if it brings conviction to the subject we shall see, shortly, that the subject is manifesting all the external signs of witnessing a very interesting phenomenon. We gain reports from the subject after the period of hypnosis is past and we discover that he has, as a matter of fact, witnessed the disappearance of the person seated upon the chair. This is called negative hallucination, but it illustrates nicely that a person may, under certain conditions, *look* and not *see*. There is a mechanism, then, in the human nervous system (or in the structure of the mind) which makes such phenomena possible. It takes no stretching of the imagination to believe that a similar mechanism lies at the basis of malingering. There really is a way of being sick because we think we are sick. And this fact helps us to understand that there is a way of becoming well again because we think we are getting well.

About the facts there can be no doubt. Questions arise when we seek to account for such strange dissociation in mental life. Some writers hold that the ailments which we call functional are really "mental" ailments, and one would not expect to find any physical or neurological disturbances accompanying them. That is, there may be genuine "mental diseases," diseases of the spirits of men, diseases of their souls. The difference between nervous and functional diseases would, then, be clear enough, even though the observed disturbances of mental life and of behavior were identical. The brain might, therefore, be subject to affliction from two sources, first, through the nervous tissue which lends itself to the service of the soul or spirit, and secondly, through breakdown or malfunction within its own substance.

A great deal of light will be thrown upon this troublesome question by considering the notion of functional derangements of the nervous system which may not be accompanied by any demonstrable pathological signs.

Functional Nervous Diseases.—The advocates of mental diseases, *i.e.*, the advocates of genuine functional diseases are right in holding tenaciously to the fact that in the post-mortem examination of many disorders no traces whatsoever of nervous pathology or disintegration are to be found. It may be doubted, however, as to whether this fact should afford anyone much comfort, for no one has any idea of what there is to look for in the nervous system. Lesions, degeneration, calcification undoubtedly occur, and when present they are always accompanied by disturbances in mental life; but that tells us nothing of what happens in the neurons or at the synapses either during the normal or the abnormal appearance of a train of ideas or a series of behavior patterns. Neither gross nor microscopic inspection will show abnormal resistances at the synapses, unusual density or unusual thinness of hydrogen ion concentration in the neurons, or anything at all of the molecular state of the protoplasms of which nervous tissue is constituted. In other words, functional disease may be a name for those derangements of nervous tissue, and consequently of behavior and of mental life, which are sub-microscopic.

Some light is thrown on this question by the conditions under which the functional disorders are produced. A high explosive shell falls near a man. He becomes functionally blind. A man is brought low by a burning fever. He forgets the events that should adhere to a certain portion of his life. Social diseases, accidents at birth, and similar conditions also lie at the basis of some derangements. Finally, many of them are hereditary. In all of these circumstances it is just as easy to believe that the fine, sub-microscopic structure of the nervous tissue is injured as to believe that a soul has suffered damage.

There is no such thing as a functional failure of an automobile engine independent of some material occasion. We say, it is true, that "it won't go today," or that "it isn't working right"; but in every such case we can find a spark plug that is carbonized or a timer that is out of adjustment or gasoline that is not properly volatilized. Moreover, there are no such things as functional diseases of the body. We say, too, of the digestive system that "it is not working properly," but we look to hyperacidity or toxic products of autointoxication and not to a vague notion of pure functional derangement. It looks, then, as though the phrase "functional disease," or "mental disease," is a phrase which we use for that residuum of nervous disorder which has not, up to the present time, lent itself to microscopic and other searching methods.

The most, if not all, types of functional disorder may be described as phases of dissociation. This idea of dissociation and its counterpart, the idea of association or integration, is one of the most fruitful ideas that has ever been introduced into psychology. We touched upon it, first, in our description of those phases of mental life and of behavior which reflect self or personality (see p. 162).

Analogies are dangerous, but with due warning we may appeal to an oft-used system for an illustration of functional unity and functional dissociation. At the time of the San Francisco earthquake all of the telephone and telegraph wires leading eastward were united, so to speak, in a functional unit for the transmitting in unison of the dreadful news. Ten days thereafter the whole system was once more "dissociated." That is, some trunk lines were carrying messages westward, some eastward, some north and southward, and each group of messages had a different import.

In normal life we may think of the nervous system as having an essential unity, that is, as much unity as would be permissible considering the facts of attention, problem-solving, and the like. In functional disorders of the nervous system we may conceive of physicochemical changes within the neurons or at the synapses which mean the temporary or permanent separation of different neuronal systems the one from the other. The result would appear in the form of behavior which reflects now the dominance of one system and, at another time, of a second system.

But physiological explanations have never gained universal acceptance and we must consider, therefore, still another way of viewing the causes of mental diseases.

Freudianism.—A remarkable picture of the nature of mental disease and an equally remarkable method of treating such disease has been given us by a Vienna physician, Sigmund Freud.[1]

Late in the last century, Freud, as a young medical student, went to Paris to continue his studies in medicine under Charcot, a physician who was, at that time, creating much interest in his adaptation of hypnosis to the treatment of hysteria. After two years with Charcot, Freud returned to Vienna and, in collaboration with an older friend, Dr. Breuer, set for himself the task of treating mental diseases.

One day Dr. Breuer told Freud of a peculiar case in which a woman suffering from a severe attack of hysteria found relief and finally a permanent cure by frankly telling Breuer the history of her case, including its origin and the course it had taken. Freud found this story of a cure by "talking" full of significance. It led him to the fundamental principle of his whole theory of mental disease and its cure, viz., that experiences, especially unpleasant experiences, are not forgotten but that they continue to live in the subconscious ready to come back into the stream of normal mental life whenever the opportunity arrives.

Memory and forgetting always have raised difficult questions. "If you ask the average person how or why he remembers he will be puzzled and he is apt to reply, 'Why, I just remember,' or 'I never thought of that before.' If you push him a bit and ask what becomes of ideas after they have passed

[1] Read Freud, S., *A General Introduction to Psychoanalysis*, 1920.

out of mind and have given place to other ideas, and how an idea that has gone, disappeared, can be brought back again as memory, he becomes further puzzled. We know that ideas that have passed out of mind may be voluntarily recalled, or reproduced, as memory; we may say that meantime they have become what may be called dormant. But surely something must have happened to enable these conscious experiences to be conserved in some way and recalled. Ideas are not material things which, like books, can be laid away on a shelf to be taken up again when wanted, and yet we can recall, or reproduce, many ideas when we want them just as we go to a shelf and take down any book we want." [1]

To provide a place for memories Freud, like a good many others, took up the subconscious. He was convinced shortly that memories are imperishable. This, he found, was especially true of the experiences of early childhood, and of all experiences which issued from conflicts between the instinctive impulses of the child, on the one hand, and the restrictions of society on the other (see p. 296). He also found, as he began to probe the unconscious by using the "talking method," that patients went back, over and over again, to their own intimate experiences and particularly to matters pertaining to sex. Freud was, from the very first, "so impressed with this fact that he asserted that in the normal sex life no neurosis is possible. Even before him, neurologists of the old school had always known that sex played a part in nervous conditions, but to them it was just plain sex, it meant just the physical elements of sex. Freud formulated a new concept of sex. To him the sexual life of the individual meant his love-life. He used the term in the broadest sense, as embracing not merely the grossly sexual, or the physical elements, but all that we commonly associate with love. He found that the conceptions of sex in vogue at his time were practically all false. It was generally held that there was no manifestation of sex until the boy or girl reached the age of puberty, when suddenly, and in some mysterious way, the sexual impulses appeared. Freud found, however, that there were sexual experiences, or feelings very much allied to sex, at the age of six or seven, or even earlier."[1]

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[1] Prince, M., *The Unconscious*, 1921, pp. 6–7.

It is now believed that Freud's conception was one-sided; but he did emphasize the dynamic aspects of mental life. The *libido*, the *élan vital*, the will to power, the urge to live, are phrases which have come out of contemporary dynamism. Freud believed that the libido or the sex urge of a growing child did not always have adequate expression. We have already seen how society acts as a safety valve upon longings and desires that the individual cannot express. Freud believed that a great many sex experiences and other unpleasant or painful experiences were being pushed back into the subconscious where they were organized into a "complex." Being full of energy, they seek constantly to renew themselves in the normal stream of mental life. This they accomplish either by proxy or by substitution or by symbolization. The latter form of reappearance is the most frequent, for the factors that originally forced an experience into the subconscious continue to hold it there and prevent its return unless it can appear in sublimated or in modified form.

According to the Freudian theory of mental disease, therefore, all the symptoms of functional diseases are signs of the existence in individuals of forgotten experiences or repressed wishes which are striving to reappear in symbolical or modified form. "A woman gets up one morning, feeling perfectly well; she sits down to her desk to write a note to her friend. She writes the date and stops; a feeling of sadness gradually grows upon her, and she decides not to write. All day she feels depressed." Under examination her physician finds that the date has struck a "complex" in her mind which runs back to an early and extremely disagreeable experience. The experience itself she could not recall nor the significance of

[1] Brill, A. A., *Psychoanalysis*, 1921, p. 22.

the date; she did experience, however, the emotion which accompanied the original episode.

Life is full of repressions, according to Freud. The infant from the very first must yield to repression for, as it grows, it finds that it must subject some of its own desires to other objects and other persons. The subconscious or the unconscious of the Freudians includes a great mass of repressed material, the sum-total of the "forbidden" experiences that have been crowded out of consciousness from the very beginning of mental life. Many of these "forbidden" experiences are the primitive impulses of infancy that must be inhibited as the infant becomes a member of society. Unless repression goes on carefully, or unless proper sublimation takes place during normal mental growth, the individual comes to maturity with a subconscious that is standing ready to damage him at every convenient moment.

We are not interested, at this time, in an evaluation of Freud's theory of mental disease. As a matter of fact, we have but touched upon a single phase of the whole theory, for Freud has brought it to bear, in one way or another, upon almost every kind of human experience. The slips of one's tongue as one speaks, or of the hand as one writes, all one's dream life, a large part of the world's best literature, art, and poetry, as well as all functional diseases, are for Freud, expressions of normal, but more often of abnormal, mental life. He has, moreover, set his whole scheme into a rather fanciful framework of theory and speculation.

There are, nevertheless, two important points for us in his scheme. In the first place, he and his followers are actually effecting cures. They do take "sick minds" and cure them in a large number of instances. In the second place, Freud has emphasized the fact that the unity of mental life is, on occasion, torn into double or multiple patterns. That is to say, minds do become disorganized or dissociated and under such conditions a number of symptoms may appear which can be used to direct a mode of treatment. The fact that his system works is a powerful testimony to the reality of functional disturbances; but the value of his mode of explanation, resting as it does upon such concepts as the soul, the subconscious, and various other dynamic mental powers and agents, must stand or fall, not in terms of his success as a diagnostician and physician, but in terms of the general mind-body problem.

The Freudian position has been neatly summarized as follows: There is (1) the fact that under the Freudian scheme human behavior, and especially abnormal behavior, is to be understood in terms of emotional and other experiences which (2) act as psychic influences in the production of both psychic and somatic disorders. In addition there is "(3) the *subconscious*, for much takes place behind the scenes and under the stage; (4) the vital consequence of *early childhood* impressions, especially (5) emotional *shocks* (psychic trauma); (6) the ever-present *conflict* of instincts and urges versus the stress of fact and social pressure, leading to the opposition of (7) the world of *phantasy* or *wish* versus the world of *reality*, experience, and logic gradually ousting the daydreaming pleasures of the imagination; this introduces (8) the *censor* and the bootlegging evasion which goes on despite all of the amendments of our moral constitution; (9) the *motive* and his several understudies forming (10) a caste of *determinisms*, neatly indicated in the lapses of speech and conduct, the letting the cat out of the bag of unintentional revelation, but more seriously operative in (11) *escape* from distressing situations, (12) *compensation* for shortcomings, and failures, and leading to the disguises of (13) *projection*, substitution, and symbolism; then the combination of these urges and mechanisms into (14) *complexes*, highly emotionalized convictions, functioning characteristically as (15) inhibitions and *repressions*, and again in an opposite rôle (16) *fixations*, or enthusiasms and fanaticisms; next the details of the plot: (17) the leading, often intrusive, rôle of the *sex* urge which Romeos and Juliettes whatever may be the ostensible story, making much of our waking behavior and still more of our private dreams possess (18) a superficial, *manifest*, patent and a subconscious and disguised *latent* content; furthermore, the plays within the play—like the 'Mouse-trap' in 'Hamlet'—such as (19) *regression*, the tendency to lapse back under strain to outgrown patterns of response, or (a different resource), (20) *rationalization* by which rich reasons are given for poor motives." [1]

Summary.—It is a misfortune for psychology that so much of Freudianism is a veritable riot of the imagination. In spite of the fanciful part, however, there is a profound truth and a profound challenge in its program. More than any other discovery or observation it has sharpened the contrast between those psychologies which are wont to go to the nervous system for explanatory principles and those that go to a real, dynamic mental life. In the Freudian psychology, mental processes are active, energetic agencies and the brain is only an instrument through which these agencies sometimes work. The Freudian psychology is the traditional soul psychology translated into modern speculative terms. It stands, therefore, in sharp contrast to the point of view expressed in Chapter I and to the point of view of a large part of modern experimental psychology. How long this contrast will last and along what lines a reconciliation will (if ever) be effected is a problem that promises to remain unanswered for some time to come.

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[1] Jastrow, J., *Psychol. Rev.*, 1927, 34, 187.

CHAPTER XIV

ANOMALIES IN THE MENTAL LIFE OF MEN. ILLUSIONS, HALLUCINATIONS, AND DREAMS

Introduction.—By "unusual" or "anomalous" we may mean three different things. (*a*) An unusual object is a relatively infrequent object. The peasant who said of the giraffe, "There ain't no sich animal" was viewing what, for him, was an anomaly in animal creation. Most of us do not experience hallucinations often enough to grow used to them and they are, therefore, for us, unusual. (*b*) The word "unusual" may imply novelty. Dreaming is not infrequent but it is novel. The objects and events seen in the dream are novel; and it is a novel fact that any sort of mental life should run its course during sleep. It is particularly unique that a person should be asleep and also awake as in hypnosis. (*c*) The word "unusual" may mean the unexplainable,—unexplainable, that is, by any of the facts with which we are already familiar. An explanation may be known to an expert or it may be discovered with a little research; but in everyday life an object or event remains unusual so long as the explanation is not perfectly obvious.

In science there is, strictly speaking, no usual or unusual. Facts are facts, objects are objects, events are events, and they become usual or unusual only as we attach values to them. It is only in this sense that illusions, hallucination, dreams, telepathy, and the like, are anomalous to the psychologist.

ILLUSIONS

The railroad tracks upon which we stand appear to meet at a point on the horizon although we know that this cannot be the case. Mountains and other objects appear now near at hand and again far away, depending in part upon atmospheric conditions, and in part upon conditions which we have presently to name; we know from other sources, however, that the mountains do not move. Sounds and objects suffer curious distortions in fogs, tables look oblong and have obtuse and acute angles although we know from the meter stick or by changing our position that they are square. Rods lowered for a part of their length in water appear to be bent, although we know from our physics that this cannot be. Lines in a house or in a garden vary in length and objects vary in size because of the context in which they happen to be placed. In short, our stock of information about objects is not always internally consistent. Experiences contradict one another. We say that there is a difference between the world of experience and the world as the physicist describes it. But the physicist can describe only the world that he experiences and it would be better to say, therefore, that owing to conditions which we shall presently name, our experiences disagree with one another in giving us a simple and self-consistent knowledge of our environments. We are, in short, subject to illusions.

The Problem of Truth and Error.—It has often been remarked by philosophers that our perception of the world through the senses is merely a great and prolonged deception. It is in the exposition of such a text that many of the most difficult problems of philosophy have arisen, for the disagreement of our perceptual experiences raises the question of Truth and Error. Almost every philosophical system has had to settle its accounts somewhere with the problem of knowing and with the reliability or the truthfulness of knowledge, whether that knowledge be furnished by the senses or by thinking or by any other power whatsoever.

Upon a little reflection it will be obvious to the reader that the problem of truth and error is of little direct concern to the psychologist. It is immaterial to him whether one line which is reported as shorter than another, actually is shorter by measurement or not. He does not greatly care whether an object which is known to be warm in terms of a thermometer is reported as warm or cold. That is to say, the psychologist is not interested in the question as to which experience represents the truth. It is possible to draw a figure in such a way (the famous duck-rabbit illusion) that upon one inspection it will be reported as a rabbit and upon another as a duck. Two questions may excite us, the one as to whether the figure we have drawn really *is* a duck (or a rabbit), the other as to the conditions under which our report changes. The events which occur external to the organism must in both cases be the same. What happens to change the report from duck to rabbit must happen internal to the nervous system and it is the business of the psychologist to find out what these events are, if such a task is at all possible. The person who knows nothing of physics would not be able to make a successful dive for an object under water. For him the object is where he sees it. After having had experience in diving or after having learned his physics he dives not where he sees the object but where the laws of refraction tell him it should be. It is not the psychologist's problem to determine where the object really is, but to find out what physical and neural conditions cause such an irregularity in two different ways of getting knowledge about a single event.

Kinds of Illusory Perceptions.—Illusory perceptions fall most readily into classes according to the mode of perception involved. There are, then, illusions which can be related to each of the receptors. Of these, tactual, auditory, and visual illusions are most frequent. Illusions of taste and smell are rather infrequent.

Tactual Illusions.—The most famous of all the illusions and the one having the longest history falls in the field of tactual perception. Aristotle was apparently the first to discover that if the second and third fingers were crossed, small objects (a pencil, for example), rubbed between them would be reported as doubled. Even though a person looks directly at his fingers and at the single object he can scarcely escape the tactual conviction that two objects are present. The illusion has been explained by showing that objects which usually touch one side of the third finger do not, under ordinary conditions, touch the opposite side of the second. Under the conditions of the experiment these two surfaces which are normally excited by two different objects are brought together in such a way that a single object satisfies the physiological conditions underlying the perception of two objects.

There are numerous other tactual illusions. Two points at a fixed distance from one another will be reported as standing at variable distances from one another if they are drawn simultaneously across the face from ear to ear or down the arm to the fingers. Two points touching the skin close together will be reported as one point. The Müller-Lyer illusion and the illusion of filled and unfilled space (see geometrical illusions below) hold true of tactual as of visual perception.

Auditory Illusions.—The most common auditory illusion occurs when some incidental and irrelevant noise is misinterpreted as the call of a friend or a neighbor. Such illusions can probably be explained in the same way that we explain our ability to understand what is said over the telephone or spoken through the phonograph or loud speaker. It has been shown that 33 per cent of the normal physical stimulus may be lacking in the telephone and yet leave the conversation understandable. This means that an inadequate stimulus may be supplemented by processes in the nervous system to such an extent that what is heard may be understood. The fact that a mangled or inadequate stimulus can become familiar to the subject shows that the nervous system is active in supplementing stimulus patterns which come to it through the receptors.

Another common auditory illusion is got when a rapidly moving train whistles as it rushes by. The whistle-tone appears to become lower in pitch. We explain this illusion by recalling that the speed of the train may be great enough, in proportion to the speed of the sound waves, to increase the length of the wave or decrease the number of vibrations per second as the source of sound is carried away from the listener.

We are subject to many illusions in the perception of the direction of sound. Sounds coming from the right or from the left are always correctly judged, but sounds coming from directly in front (assuming we do not already know the location of the resounding object) may appear to come either from the front or the rear. Likewise sounds from the rear may appear to come from in front of us. This illusion is explained by the fact that localization depends upon phase difference in the two ears. That is, the sound wave must strike one ear slightly ahead of the other if the sound is to be accurately located. Sound waves coming from in front or from behind strike both ears simultaneously and if, therefore, we are to locate the sounding bodies, we must do it in terms of information from other sources. This, as a matter of fact, is what happens in almost all sound localization.

Visual Illusions of Movement.—Visual illusions are by far the most frequent in our experience. We mention, first, visual illusions of movement. The common experience of judging ourselves to be moving when the train on the next track is moving, or of believing the moon to move instead of the flying clouds, are cases in point. An illusion of more unpleasant character results from looking steadily at a flowing stream while standing on a bridge above the stream. Presently the observer feels himself and the bridge to be hastening rapidly upstream while the water itself appears to be standing still.

Illusions of movement depend upon factors which are not as yet clearly understood, but we may get a suggestion of the physiological conditions by considering the illusions of movement which appear after turning rapidly about on the heel three or four times. If we turn rapidly to the right objects appear to be whirling just as rapidly to the left for a moment or two after we come to rest. We know that quick jerky movements of the eyes produced by excitations from the organs of balance in the inner ear have something to do with this apparent movement of the visual field. We know that by pressing the finger into the edge of the eye and thus moving the eyeball jerkily, external objects will jump here and there just as jerkily. We may assume, therefore, that the eye movements arising from our observation of the flowing water or the flying clouds have something to do with the illusory judgments we make about these objects.

The Geometrical Illusions.—In addition to these visual illusions of movement there are a great many illusions of distance, size, direction, and the like, which can be exemplified by geometrical figures. These illusions were introduced into psychology in 1854 by a man named J. Oppel. He called them the "geometrical optical illusions" and under that name there has appeared a very large number of papers purporting to describe new illusions or to explain the older ones.

The geometrical illusions fall readily into four classes. There are, in the first place, groups of lines and of figures giving illusions of *reversible perspective.* If one draws two lines upon a blackboard crossing one another in such a manner that they make an acute or obtuse angle, the lines will appear to run now away from the observer and now toward him depending either upon the sort of eye movements that are made during the period of inspection or upon the direction which one "chooses" to see. A more common illusion of this sort arises from a simple, schematic drawing of an open book. As the eye movements change in direction the book appears to stand open with the pages forward or with the back forward as the case may be. In a similar manner, a flight of stairs may appear now as a flight of stairs and again as an overhanging fresco; or a cube drawn with all corner lines showing appears now as if seen from above and again as if seen from below. In all of these illusions, the perspective actually appears to suffer alteration.

The second group of geometrical illusions are the *illusions of extent.* If a line one inch long is drawn upon a piece of paper and then compared with a similar line which has been crosshatched, the crosshatched line will be judged much longer than the simple line. Likewise, two points one inch apart will appear to be separated by a greater distance than the two ends of a straight line one inch long. From a large number of illusions of this kind, the generalization has been drawn that filled or divided space appears greater in visual apprehension than empty and undivided space. Although certain qualifications have to be made, the principle holds. The most famous of the illusions of extent is the Müller-Lyer or arrowhead illusion, an illusion which takes the following form. At both ends of a line an inch long place "arrowhead" lines pointing inward. Upon another line of the same length place arrowheads pointing away from one another. When these two lines are set side by side the first will appear much greater than the second. Many modifications of the illusion have been devised. A circle one inch in diameter when placed concentric to a circle ten inches in diameter is judged as very much smaller than when placed concentric to a circle two inches in diameter. A line two inches long set between two lines one inch long appears very much longer than a line of the same length set between two lines four inches long. The area inclosed by a semicircle without its diameter appears greater than the same area after the diameter is drawn in. A square with one side missing seems, likewise, to include a larger area than when the fourth side is added. If a line one inch long is erected vertically and at the middle of the horizontal line of the same length, the vertical line appears the longer.

The third class of illusions are the *illusions of direction.* If, from a point midway between two parallel lines, a large number of radiating lines are drawn, the parallel lines will appear to bulge out near the point of radiation. If two points of radiation are set outside the parallel lines and if the radiating lines are drawn to meet at points halfway between the points of radiation, the parallel lines will appear to converge or to be drawn together opposite the points of radiation. Parallel lines that are diagonally crosshatched seem to bend now to one side and again to the other. This illusion often appears in dress goods.

All illusions which involve complications of the factors already mentioned and a large number of special illusions may be grouped, for convenience, into a fourth class. In estimating the extent of various geometrical forms which lie near together, it is said that we are influenced in our judgments by the mere fact of their close association. The estimation of distances which are set into complicated patterns involves all of the factors mentioned above.

Explanation of the Geometrical Illusions.—Perception marks a process in which two variable factors take part, viz., the environment with its properties and the organism with its properties. We should expect, therefore, to find illusions explained in terms of these two variables. As a matter of fact we have already some suggestions that this is the case, for the rod 'bent' in the water is explained by the laws of refraction, a fact which belongs to physics, while illusions of movement are explained by eye movements, a fact which pertains to the organism and its properties.

Most of the explanations of the geometrical illusions make use of one or more properties of the organism, either of the receptors themselves or factors within the central nervous system. By way of illustration we shall distinguish four such theories. The first is known as the eye-movement theory, a theory propounded by Wundt. It is presumed by this theory that the eyes move more readily in some ways than in others and that, accordingly, the judgments of geometrical form are apt to vary as eye movements vary. It is alleged, for example, that vertical movements of the eyes require more effort than horizontal movements and that, therefore, the vertical lines appear longer. Divided space or filled space impedes the movement of the eyes and so appears greater. Acute angles are supposed to initiate abrupt changes in eye movements as opposed to the slight deviation caused by obtuse angles. Photographs of eye movements, however, do not altogether favor this theory. The theory is further complicated by the fact that whereas long fixation may diminish the illusion, a very short fixation—too short for movement—appears actually to favor it.

A second theory has been called the perspective theory. It is alleged that geometrical figures tend to take tridimensional form with the result that areas or distances are modified in their relations to one another as in stereoscopic vision. The vertical line upon the horizontal line, for example, appears longer, it is alleged, because it is interpreted as stretching away in the distance. The perspective theory fails, however, when applied to many other illusions.

A third theory is known as the dynamic theory. In terms of this theory the observer is supposed to read himself into the geometrical figure and his judgment is based upon the figure as it "feels" to him. Spaces that are limited or bounded appear smaller than open spaces, since the organism actually feels limited or expanded, as the case may be. The theory even runs to fanciful explanations involving some of the dynamics of nature. The length of a line varies, it is alleged, as the line runs with or against gravity.

The fourth theory is known as the "association" theory or the "confusion" theory. In the Müller-Lyer illusion, for example, the theory contends that the observer takes account of the distance between areas instead of observing the length of the lines. The arrowheads are judged as units and the estimated distance is the distance between these arrowheads and not a judgment of the length of the lines. By practice an observer may free himself from the complications arising out of the arrowheads and finally attain a fairly accurate judgment of the actual lengths involved.

Illusions of Memory and of Recognition.—We often say of a passing face upon the street or of a bit of scenery or of a melody or of a situation that we have seen the face or the scenery or heard the melody or been in the situation at some previous time, but all of our attempts to locate the event at a definite time and place are futile. William James wrote discerningly of these queer illusions when he quoted from Tennyson:[1]

> Moreover, something is or seems,
> That touches me with mystic gleams,
> Like glimpses of forgotten dreams—
>
> Of something felt, like something here:
> Of something done, I know not where:
> Such as no language may declare.
>
> *The Two Voices.*

There are other experiences in which we are convinced that our recognition, or our sense of familiarity is justified only to discover that we must be mistaken. We know little of the origins of these strange illusions but psychologists have ventured the guess that some one phase or moment of the total experience may serve as the associate bond between the present and the past, even though all other phases or moments may be different.

Hallucinations and Visions

Illusions mark discrepancies between knowledge or information gained in one way as against knowledge gained in another. The plumb line says that the columns of a building are slightly bulged in the center. The eye says that the pillars are straight. This is a common architectural illusion. There are times, however, when a subject reports the presence of pillars where no other persons can verify the report. The report that objects are present when all other data show that they cannot be present is called an hallucination.

We have already found instances of hallucination which appear under fairly normal conditions. The eidetic imagery of children means that under the conditions already mentioned children describe objects and events which are not physically present, but which have many of the characteristics of ordinary objects and events, viz., definiteness, completeness, and objectivity.

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[1] James, W., *Varieties of Religious Experience*, p. 383.

We shall meet another group of hallucinatory experiences when we consider in the next section the nature and causes of dreams. Except for dreams, eidetic imagery, and an occasional case of 'normal' hallucination, we meet with hallucinations only among the mentally sick and as the result of certain kinds of drugs.

Mescal Visions.—In one observer the taking of peyote or mescal (a drug known for many centuries to the Indians of the Southwest) resulted in the following visions:[1]

> "Clouds from left to right through optical field. Tail of a pheasant (in center of field) turns into bright yellow star; star into sparks. Moving scintillating screw; 'hundreds' of screws. A sequence of rapidly changing objects in agreeable colors. A rotating wheel (diameter about 1 cm.) in the center of a silvery ground. Suddenly in the wheel a picture of God as represented in old Christian paintings. Intention to see a homogeneous dark field of vision; red and green shoes appear. Most phenomena much nearer than reading distance."

> "Wonderfully cut deep red jewels constantly changing in size, shape, color, and distance from each other. Sometimes covered with silvery or greenish drops. The whole very symmetrical. The design on a background the color of which changes frequently. Try to see the experimenter; but blue clouds, a church, the dim face of an old man on background, blue arabesques. The whole seen through a steel veil the meshes of which are constantly changing in size and form."

> "On stationary background rotating jewels revolving around a center. Then, with a certain jerk, absence of all motion. Regular and irregular, forms in iridescent colors reminding of radiolaria, sea urchins, and shells, etc., in symmetrical or asymmetrical arrangement. Shells illuminated from within radiating in different colors, moving towards the right, turned about 45° towards the right and somewhat towards me. A little piece in every shell is broken out. Slow majestic movements along differently shaped curves simultaneous with 'mad' movements. Feeling there is 'motion *per se*.' Man in greenish velvet (height about 7-8 cm.) jumping into deep chasm. Strange animal turns into a piece of wood in horizontal position."

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[1] Klüver, H., *Amer. J. Psychol.*, 1926, 37, 504–505.

In the above accounts of the visions seen after the taking of mescal we are reminded of certain facts which we have already described, viz., the mystical visions and hallucinations of the saints and the eidetic imagery of children. We have yet to describe certain phenomena of a similar nature, viz., the imagery of dreams, the visions which are experienced by mediums during crystal gazing and trance, and the visions and hallucinations experienced during high fever or under various types of mental disease.

In our explanation of dreams and in the description of mental diseases we shall find plenty of facts to account for visions and hallucinations of all types. In a prefatory way we may insert the note at this point that hallucinations represent mental activity which is conditioned largely if not entirely by events and processes internal to the nervous system. In ordinary perception and in illusory perception, the objects seen, heard, or felt depend, in part, upon stimuli external to the organism and, in part, upon events internal to the nervous system. During hallucination, on the contrary, the nervous system plays either a dominant or an exclusive rôle. It is easy to see that illusory perceptions which depend more upon central factors and agencies than ordinary perceptions may grade insensibly into hallucinations as the dominance of the central factors increases.

The "Sense of a Presence."—An indirect proof that hallucinations and visions such as we have just described may owe their origin to hyperactivity in some portion of the cerebrum comes from individuals who have lost a limb or an arm and yet who, for years afterward, experience sensations which are referred to the missing member. It is the absent foot that cannot be stroked when it pains or scratched when it itches, not the stump that is left. It may be that irritation of the nerve stumps may have something to do with these strange perceptions, but the nervous functions that underlie dreams are equally adequate to cause these dreams by day. Likewise, both central and peripheral stimulation may account for strange illusions and hallucinations in the skin and in the body. Changes in the temperature of the skin and the processes of metabolism, when taken in conjunction with central factors, lead, no doubt, to that curious experience known as the "consciousness of a presence." The facts may be illustrated in the following quotation: "It was about September, 1884, when I had the first experience. On the previous night I had had, after getting into bed, at my rooms in College, a vivid tactile hallucination of being grasped by the arm, which made me get up and search the room for an intruder; but the sense of presence properly so called came on the next night. After I had got into bed and blown out the candle, I lay awake while thinking on the previous night's experience, when suddenly I *felt* something come into the room and stay close to my bed. It remained only a minute or two. I did not recognize it by any ordinary sense, and yet there was a horribly unpleasant 'sensation' connected with it. It stirred something more at the roots of my being than any ordinary perception. . . ."[1]

The assurance of the person who relates such an experience that he has gone beyond the limits of ordinary perception is not evidence, of course, that he has actually done so. He lay "thinking of the previous night's experience" when the presence was felt. Skillful persons are able to follow this formula at almost any time. The difference between the two reports depends upon a difference in the way the two persons allow themselves to be saturated with the experience. Any intense or vivid experience has a mystical quality about it which turns upon emotional attitude and not upon new or unique types of intellectual function.

DREAMS

All the world will listen to a "good" dream; hence the great amount of anecdote. Up until the present century, there has been only a meager amount of experimental fact about dreams and dreaming.[1]

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[1] Quoted by James, W., *Varieties of Religious Experience*, 1915, p. 59.

Historical Notes.—The historical literature concerning dreams shows us that philosophers, men of science, and romanticists have been interested in the fact of dreaming as far back as written history goes. Democritus, to take an ancient figure, believed that the air was full of the phantasms of corporeal or real objects and that these phantoms entered into the soul during sleep in order to induce dreams. Aristotle, who sounds so strangely modern and at the same time so strangely occult in much of his natural science, affirmed that dreams are due to the impressions left in the sense organs by the experiences of the day, a doctrine held in opposition to his master Plato, who had said that it was the soul which, by continuing its normal activity during sleep, causes the dream. Pliny believed that dreams came partially from sleeping too soon after meals and partially because of supernatural impressions. The Stoics attributed all dreams to divine sources. Thus we have, among these few ancients, most of the explanations that are familiar even to modern science; but, in ancient days, one opinion was as good as another and each remained so until the beginning of the present century, when serious attempts were made, for the first time, to reduce the problem to an empirical and experimental level.

The experimental era was opened by Vold, a Norwegian writer, who set down for careful study the dreams of thirteen years. A similar study was soon made by Nilson who gathered together 1,000 of his own dreams for closer study and analysis. By 1912 several attempts had been made to use the introspective method in describing dreams and since that time material progress has been made in understanding not only what goes on during dreaming but why it goes on. Even yet, however, the field is open territory to investigators.

Difficulties in the Experimental Study of Dreams.—The application of experimental methods to dreams has been hindered in several ways. In the first place, the physiologist and the neurologist have not succeeded in describing the physical conditions underlying or causing sleep. Although the problem of the psychologist is not essentially related to the cause or to the origin of sleep, nevertheless knowledge of the physiological conditions underlying the ebb and flow of neural processes during the night might help materially in stating the problem. In the second place, memory for dreams is extremely inadequate. There is, for example, little correspondence between the temporal relations obtaining during the dream panorama and those obtaining as we tell our dreams in what may be a disarranged or distorted temporal sequence. There is, moreover, plenty of evidence to show that one must form the habit of remembering and telling dreams if one is to be at all accurate in one's information. In the third place, we try to make good stories out of our dreams. The breakfast recital of a dreamer is usually far from a controlled observation, for he is not regarding processes; he is telling of the sequence and of the uniqueness of objects and he is probably adding thereunto certain reflections of his own immediate construction. Still more frequently the description of a dream itself is neglected in favor of a description of the organic events and of the emotions aroused at the moment of telling, events which refer, by way of memory, to the supposed affective experiences of the dream itself. In the fourth place, it is alleged with some show of exactness that only abnormal dreams are well remembered. That is to say, attention is so low during sleep that the most of our dreams, save the unpleasant ones, are immediately forgotten. In the fifth place, dreams must be "caught upon the wing." One cannot toss them up as one does a clay pigeon on successive occasions. The conditions under which dream imagery appears are not under immediate control and it becomes necessary, then, to await their appearance whether the conditions of observation are suitable or not.

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[1] Read Freud, S., *The Interpretation of Dreams*, 1915.

These difficulties have not proven to be insuperable, however, and the psychologist has, up to the present moment, used several devices of practical value in analyzing dream experiences. It must be remembered that the task of the psychologist in this field rests not upon a mere enumeration of the number of dreams or of the kinds of objects to be seen or heard or felt in dreams. The mentalist, at least, is searching for mental processes and types of mental organization.

As we have seen, empirical methods began with Vold's account of his own dreams. In 1893 M. W. Calkins, following a clew given by other investigators, improved the method by examining the dreams of two observers who had been instructed to take advantage of chance awakenings during the night. On these occasions, the subjects were asked to report, with some care, the dreams, if any, that had just occurred. This introspective method has been supplemented by appealing to the behavior of an individual during sleep. It has long been supposed that the involuntary movements of dogs and other animals during sleep were due to dreams. Jastrow seems to have been the first to make definite use of this sort of material, for it became quite significant during a study of the dreams of Helen Keller. The lack of auditory and visual perceptions apparently limited Miss Keller to cutaneous and organic processes and her dreams were, accordingly, accompanied by many bodily movements. If the behaviorist were able to make observations on the vocal cords during sleep he would doubtless find enough evidence to support his objective program.

Frequency of Dreams.—Although the study of dreams is still far from complete, a number of interesting facts have been discovered regarding them. In the first place, certain information is at hand concerning their frequency. The facts suggest that there may be no such thing as a dreamless period of sleep. The inability to recall a dream is, of course, no proof of the non-existence of the dream. Remembering a dream depends upon its coherence, upon associational ties, upon the depth of sleep and, especially, upon one's habitual attitude toward recalling or forgetting dreams. Most of the dreams which we remember and can relate occur, so we find, during the period of light sleep, *i.e.*, either directly after falling asleep or between the fifth and eighth hours; but we are not justified in assuming, therefore, that no dreams appear during the period of heavy sleep. All of the sense organs, including the eyes, may be functionally alert during sleep (some light may penetrate the eyelids) and activity in the central nervous system may go on at the same time; these would suggest the possible occurrence of fragmentary and unclear dreams during the deepest sleep. Furthermore, it has been possible, under hypnotic conditions, to make individuals recall and relate many dreams that could not be recalled in normal waking hours but which, when described during hypnosis, carried an unmistakable feeling of familiarity. There is, of course, no positive proof at present that an individual is constantly dreaming during the sleeping period; but assumptions regarding neural and mental functions and the facts we have stated would seem to suggest that dreaming is far more frequent than is usually admitted. Dreaming is probably so frequent that no single sleeping period passes without several dreams appearing during its course.

Number of Dreams and the Depth of Sleep.—It has been discovered that dreams tend to become more frequent toward the end of a sleeping period. According to studies made on variations in the depth of sleep it appears that consciousness is at its lowest level during the second and third hours of the sleeping period. Reported dreams are fewest during these hours. As the night passes, sleep becomes lighter and dreams more numerous, so that between the fifth and seventh or eighth hours of sleep a curve showing the number of dreams reaches its maximal value. It must be added, however, that this curve represents dreams clear or intense enough to be remembered easily. As we have stated, there are many reasons to believe that dreams occurring early in the night are forgotten as soon as they have run their course.

Age and Sex Differences in Dreaming.—There are in the next place, definite age and sex differences in the number of dreams. On the basis of reports from untrained individuals, about 13 per cent of the men and 33 per cent of the women contend that they always dream; 27 per cent of the men and 45 per cent of the women admit frequent dreams; 50 per cent of the men and 13 per cent of the women insist that they rarely dream; while 9 per cent of the men and a similar number of women report that they never dream. For reasons which we have already stated, such statistics are apt to be exceedingly unreliable; but with due allowance for the degree of unreliability, sex differences in dreams still appear. Alleged differences in age are based upon the same kind of evidence. It appears, for example, that very young children and old people dream more rarely than adults in middle life. Compayré interpreted movements in a sleeping baby as indicating the occurrence of dreams in the fourth month; but De Sanctis found dreaming very rare among several boys eleven years old. Other investigations suggest the conclusion that dreaming becomes more frequent beginning with the fourth year and the number of dreams is alleged to reach a maximal value between the ages of twenty and twenty-five. De Sanctis found that dreams were rare among individuals sixty-five years old and that the material was usually drawn from their earlier lives.

The Influence of a Direct Stimulus upon Dreaming.—Heerwagen found that when his observers had looked at colored papers before sleeping, 60 per cent of the dreams were composed of visual, 5 per cent of auditory, 3 per cent of gustatory, and 1.5 per cent of olfactory material; but when taste and smell had been excited before the sleeping period, visual dreams fell to 50 per cent of the whole number and the percentage of dreams for the sense organ stimulated was doubled. This is only one of dozens of experiments which support our daily story of how the sound of the alarm clock became the cardinal feature of our waking dream.

It will be illuminating to list some of the events that may excite a dream or enter into its content. Smoke from a bonfire, or from a neighbor's chimney, the moon shining in the eyes, street noises of all kinds, a bad taste in the mouth, uncomfortable position of the body or stricture from the covering, cold from insufficient covering or warmth from too much, creases and folds in the bed, movements of a sleeping companion, thirst, bladder distension, hunger, indigestion, emotional or other excitation which hangs over from the hours before sleeping,—any one of these may initiate or enter into a dream.

The specific source of dream materials which do not owe their origin to direct stimulation has been under dispute. It has been urged with equal authority that, on the one hand, the dream contents come out of the irrelevant details of the day preceding and, on the other hand, that dreams always refer to the most important events of the day before. One experimental study has shown that of the persons appearing in 54 dreams, 64 were recognized and 45 were unknown. There were 14 familiar scenes and 44 were unfamiliar; but these latter contained many glimpses of objects taken from familiar scenes. Most of the references in the dreams were to the events of the preceding evening or of the preceding day. On the whole, it is probable that the "primary and chief incentive to reproduction in dreams is furnished by recent cortical functions and the bizarre and novel character of the dream is owing to the fact that bits are torn from the most diverse interests and topics of the preceding day and composed in a single scene."[1] But in the large, the dream undoubtedly runs its course under the influence of old determining tendencies, a fact which accounts for the frequent allegation that dreams usually betray the personality of the dreamer.

Dream Imagery.—Visual and auditory imagery is, by far, the most common constituent of dreams, while other sense departments are represented in smaller measure. Grays are more frequent than color qualities. Unpleasantness appears about twice as often as does pleasantness, and emotional complexes of various kinds contribute generously to the dream period.

The dreams of the blind furnish an interesting confirmation

[1] See Bentley, M., *Amer. J. Psychol.*, 1915, 26, 196–210.

of experimental studies regarding the nature of dream imagery. Jastrow has made a study of the dreams of the blind and finds in support of an early study of Heerman that when blindness is congenital or when it overtakes a person before the fifth year visual processes are absent in his dreams. Persons becoming blind in the sixth and seventh year have occasional dreams using visual materials, while individuals becoming blind after eight years of age all have visual imagery. Hall has given a complete account of the dreams of Laura Bridgman, who is blind and deaf. Her dreams reveal no visual or auditory processes; they are constituted almost entirely of tactual and kinæsthetic processes. The lack of visual perceptions is probably responsible for the fright she experiences when dreaming of an animal, for the object is always dreamt of as having come in contact with her body. The conversations in her dreams depend almost entirely upon finger manipulations. In the case of Helen Keller, Jastrow has been able to trace the development of the content of her dream life as her education increased. All of the studies on the processes involved in dreaming seem to indicate that dream life is continued on much the same content level as the waking life. This means, of course, that the nervous system works during the night according to the same laws which are operative during the day.

Higher Intellectual Functions in Dreaming.—There is, apparently, no foundation for the assertion that people do not think in dreams, that dreams are wholly irrational, that incongruities are not recognized, and that dreams do not pursue a given topic. A classical example of the creative power of a dream is found in the case of a certain Dr. Hilprecht, who discovered in his dreams a means of interpreting an ancient inscription. This discovery was explained as due to the unusual, even supernatural nature of dream life, but we can, so it appears, explain it otherwise. Coleridge, Franklin, and Stevenson, among many others, have obtained material from their dreams for some of their best writing. The discovery of the psychophysical principle by Fechner was due to the dream-like imagery of an early morning period of reflection. Kekule, the chemist, is said to have pictured some of his chemical formulæ (benzine ring) according to the antics of a number of dancing particles seen in a dream. It must be remarked, however, that a part of the coherence of a dream and a part of its cleverness is put into the dream by the recital.

Duration of Dreams.—Attempts to measure the actual duration of a dream have not been very successful. There is a large amount of evidence, however, which suggests that most dreams are fairly brief and that their apparent duration is a distortion due to the temporal course into which our recital of the dreams must fall. Many dreams are topical in their associative pattern and this peculiarity has probably given weight to the belief that most dreams are instantaneous.

Daydreams.—Many attempts have been made to point out the general differences and similarities obtaining between the dreaming state and the waking mind.

Men dream when they are awake. They build castles in the air and harbor elaborate ambitions which are called daydreams; but there are also times when men actually dream when the sun shines. For example, one may become so completely relaxed that even the perceptual field becomes disorganized, disintegrated, and objects are then seen in unusual temporal and spatial patterns. Some of these daydreams border on the edge of hallucination and even of trance, a fact which goes to show that all of these phenomena may have a common origin.

Absent-mindedness, a condition which we shall meet again under the topic of hypnosis, is a type of daydreaming. The man who "scratches his pancakes and pours syrup down his back" is certainly acting no more grotesquely than we all act at times in our dreams. His very absent-mindedness means the same sort of disintegration in mental life or in the nervous system that we find in the dream. And in addition to these instances there is plenty of evidence to show that dreaming and waking life are not so far apart in their natures as we commonly suppose.

Theories of Dreaming.—After this brief survey of the principal facts concerning the dream we must turn to the explanations that are offered for the fact of dreaming. Why should mental life appear during deep sleep? Why should behavior patterns begin and run their course when we might expect that the whole musculature should be inert?

Of the many explanations to be found in the literature, one of the most venerable attributes dreams to supernatural or divine origin. This explanation of dream life is found frequently in the religious and philosophical writings of the Greeks and the Jews. Jacob's ladder and the warning to Joseph are typical examples of dreams, due, it is said, to supernatural causes. Science is not inclined nowadays to consider explanations of this type.

Dreams have been attributed, in the second place, to the continuation at a low energy level and in an unorganized or dissociated way, of the same neural functions which condition the mental life of our wakeful hours. Attention has been called to the whimsical organization of the dream content as evidence of the fact that the nervous system is not only dissociated but also working at low energy levels. This theory may rest finally upon some such conception of sleep as appears in the retraction theory. According to this theory sleep is supposed to result when the axons and dendrites withdraw from one another by an amœboid movement, either because of fatigue or because of habit or because of some hereditary tendency. The withdrawal of the neurons from one another would cause the resistances at the synapses to rise. If we think of resistances which are increased in an uncoördinated manner we can see how behavior patterns and conscious patterns might appear so bizarre. If we think of the nervous system as always organized into systems which reveal themselves as movement systems (see p. 150) we can think of the structure of these systems as being disturbed or the relations between the systems as suffering disruption (dissociated) by any cause whatever and thus account for the sketchy nature of the dream life.

Finally, dreams have been attributed to wish fulfillment. We shall refer but briefly to the facts here, leaving the main exposition for a later chapter. It is Freud's theory that in most individuals unsocial tendencies and disagreeable experiences tend to be repressed. On the neural level, however, these experiences are apt to persist and find expression for themselves in sublimated form. Freud has postulated a sort of controlling activity in mental life which he calls the "censor," and, in crude terms, we may speak of many experiences—especially those related to the fundamental life urges—as seeking to recur in such form as to avoid the censor. Freud has turned to certain experiences of everyday life and to dreams for examples of this sort of escape and he finds that dreams are experiences that are essentially symbolic in nature, that they take the form they do because of the effort of some unfulfilled desire to pass the "censor." So it comes about that in the Freudian psychology dreams issue from all kinds of hidden complications and unfulfilled desires or wishes which, if undertaking to appear in unmasked form, would immediately be suppressed.

What are the facts? Where shall we turn for an explanation of dreams? On the negative side one may feel confident that dreams are not of divine origin. There is no known mechanism by means of which the nervous system of a sleeper could be "supernaturally" impressed. Neither are dreams the expression of a higher order of mentality. There is no doubt that useful material can and does frequently come from the dream state; but we are not thereby justified in arguing that a person is expressing himself, during sleep, through the channel of abnormal movement systems. On the other hand, we cannot assume, because some dreams are fragmentary and illusive, that all are, therefore, caused by a nervous system operating in a totally disorganized manner. As we have already found, the dream life may be organized in an elaborate way under individual if not racial tendencies. It is also entirely probable, as the Freudians urge, that some dreams are due to deep-lying neural organizations that do not find a normal means of integration with other neural tendencies and that, when the affairs of the day have fatigued the inhibiting neural organizations, the outlawed organizations seek expression in terms of the material at hand. On the contrary, however, experimental evidence shows that many dreams are due to direct excitations of the sense organs which initiate, in turn, sufficient central excitation to bring about the dream organization.

As a matter of fact, it has been customary to distinguish two kinds of dreams. The first kind are known as presentative dreams, for they owe their origin directly to the action of stimulating objects upon the bodily receptors, both central and peripheral. The second kind are the representative dreams. They owe their origin and their course to the reestablishment in the nervous system of old cerebral functions and determining tendencies. The wish dream, then, falls under this heading. In any case, it appears that an explanation of dreams must be sought in the operations of the nervous system. So soon as our knowledge of neural function and organization is adequate, just so soon will our knowledge of the cause of the dream be more complete.

Telepathic Dreams.—We must add a word now concerning the alleged telepathic and supernormal character of dreams. We cannot dismiss with flat denial the alleged existence of premonitory or of telepathic dreams when the belief in them is so widespread and in some cases so cherished. We must urge, however, that the simplest explanation is always the best providing the simple explanation really does take care of the facts. The "principle of parsimony" holds here as well as elsewhere. If this principle does not take us far enough, a mental reservation is better than mere hypotheses when the facts seem, for the moment, unexplainable. But there is reason to believe that the nervous system is frequently set or prepared for function by excitations of insufficient strength to condition either clear mental life or an observable reaction. There may also be many neural organizations in progress which come finally to such a level that consciousness is conditioned without antecedents. It may even be possible that a "foreboding," or an obscure restlessness, can be carried at a low level of attention, and then drop out, never to be referred to again unless some event happens to increase its intensity and clearness. The "forebodings" that do not materialize we forget. Others we remember and elaborate upon.

It is said that a man dreamed several days before the event that Chicago would burn. Now it must have been the half formulated thought of a great many individuals that a large city of frame buildings would burn rapidly under appropriate conditions. Any high wind or any one of numerous small fires might give rise to such an unformulated but easily forgotten conjecture. *Once*, however, the dream and the fire occurred together. Men like to count their hits; the misses are taken for granted or are forgotten. So it is alleged that the burning of Chicago or the death of a friend or an accident to one's family was forecast by a dream.

During the recent war much was made of a few cases where mothers dreamed in detail of the death of sons only to receive within a day or two messages announcing the actual facts. No one has thought to inquire, however, how frequently worried mothers and distressed sweethearts dreamed the same dreams and forgot them; for no message came to remind them of their telepathic abilities. The belief that dreams are inherently telepathic is but another evidence of occultism, of mental inebriety; it is another remnant of the days of magic and of superstition. A dream conditioned by organic and neural conditions is comprehensible; it bears the earmarks of healthy-mindedness. A dream that mysteriously overreaches time and space and dips into the future smacks too much of uncritical emotionalism.

CHAPTER XV

OCCULTISM, PSYCHIC RESEARCH, AND TELEPATHY (PARAPSYCHOLOGY)

Introduction.—Science has risen to its present level in spite of two serious obstacles. On the one hand, it is blocked by nature herself. There is, in the world, much that cannot be directly observed, since many facts and events do not lend themselves readily to careful study. Methods must be formulated, apparatus devised, and experiments repeated by the hundreds in order to establish most facts. Sound knowledge demands patience, toil, and even privation. On the other hand, science is blocked by man's crude comments about nature. Common opinions grow like a mushroom but they die hard. Specious knowledge comes without toil or method. Many of us are prepared to accept and to act upon coincidences, chance observations, worn-out beliefs, speculations, superstitions, and traditions, even though facts are to be had for the asking.

It is almost incredible that after several centuries of progress in the physical and chemical sciences, we should still find individuals who hold that the earth is flat or that the stars are holes in the heavens. "One Hampden declares the earth to be a motionless plane with the North Pole as the centre; one Carpenter gives a hundred remarkable reasons why the earth is not round, with a challenge to the scientists of America to disprove them; one Symmes regarded the earth as hollow and habitable within, with openings at the poles, which he offered to explore for the consideration of the 'patronage of this and new worlds'; while Symmes, Jr., explains how the interior is lighted, and that it probably forms the home of the lost tribes of Israel; one Teed announces on equally conclusive evidence that the earth is a 'stationary concave cell . . . with people, Sun, Moon, Planets, and Stars on the inside,' the whole constituting an 'alchemico-organic structure, a Gigantic Electro-Magnetic Battery.'"[1] A Kansan is defrauded of thousands of dollars by a "scientist" who explains that he has constructed a gigantic scoop upon the North Pole, a scoop which will, because of the earth's rotation, take up ice and deposit it on the farmer's own land—ice for a song. Another pays $15 for a box seat in a large city to see the world come to an end. Still another fills the crevices of his house with wax in order to survive our passage through the tail of a comet.

False opinion in the physical sciences is by no means so common, however, as it now is in the mental sciences. There was a time when angels guided stars and demons lived in metals. Now both are alleged to animate the body. The other sciences have passed on to psychology a heritage of superstitions, beliefs, and practices that have done more than any other thing to deprive the science of the respect of men of sound training. The examples we have given of error and absurdity in geography or physics are extreme if not incredible; but psychology is full of such stuff and men of standing in other fields boast of its existence. Minds are said to transcend space in a mysterious fashion; knowledge is alleged to be fixed in etheric vapors; there are said to be subtle and mysterious psychic threads which tie us to other worlds; there are magical taps, currents of air, moving tables, clammy objects against the skin, protoplasmic excitations, and other dignified (hic!) signs of spirit existence. Character is seen in crystals, the future in fits of abstraction, and the dead are reborn on photographic plates. According to one man every thought and act of our lives is transfixed on the etheric vapors that surround our earth, and it is, therefore, only natural that a clairvoyant should be able to see these fixed events and write them down afterward from the ethereal inscriptions. It is said by one

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[1] Jastrow, J., *Fact and Fable in Psychology*, 1900, p. 2.

"investigator" that, in the case of dreams, the right and left cerebral egos, united with one sublime ego, are in the body in a loose union in possession of an amœboid cell. During sleep they may separate. The sublime ego wanders through the nerve paths to the bowels, and the bowel experiences are the dreams. The author of this explanation for dreams dyed some crackers blue and later dreamed of a train of blue carriages. Each carriage was alleged to correspond to a granule of starch in the crackers and the ego which saw the parts of the crackers was, therefore, about 1/1000 of an inch long.[1] Here is true science indeed!

It is true, of course, that movement systems go wrong; dreams of strange import run their course during sleep; mental life falters; human beings fall into curious perversions; they carry out unusual performances; they display now the dull, slow operations of the feeble-minded and again the brilliant, constructive achievements of the genius; their intellects get themselves organized into double or multiple patterns; their lives are distorted by fears and by losses of memory; it is alleged that they receive messages from the "dead"; in a word, the objects of the psychologist's regard present, in their various aspects, as many striking features as does the material of any of the other sciences. It may be that psychology suffers no more in this respect than did physics and chemistry and biology at a similar period of time after their foundation; but, as we have said, uncritical persons are still playing upon this phase of the discipline and some of the unusual mental states and performances and many of the borderline problems of the science are, as a consequence, shot through with magic and superstition.

Meaning of Occultism.—Occultism is a word used to denote beliefs and prejudices like those we have just listed. Occultism is a general way of regarding the world. It adopts an uncritical point of view, makes its appearance under conditions we shall presently name, and it bids fair to persist so long as people refuse to regard the world thoughtfully or so long as the human desire to tell a good story may persist. The occult frame of mind may readily be taken as evidence of a certain degree of mental ill health, for the magically inclined individual is often disturbed by fears and morbid speculations concerning the nature and possible influence of mysterious forces and powers about him. The world as viewed by the occultist is an erratic world full of awe-inspiring energies and powers before which one must either live in perpetual fear or else retreat to the solace of religious mysticism where faith in some outside source of protection will furnish a possible guarantee against danger. The occult world is a world in which all kinds of mysterious devices and absurd performances are sanctioned as a means to deep and hidden knowledge. Divining rods, crystals, darkened chambers, cabinets, spirit photographs, and automatographs yield knowledge of the present, past, and future.

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[1] See Münsterberg, H., *Psychology and Social Sanity*, 1919, p. 124.

Occultism and Psychology.—It would not be worth while to devote a chapter of a text on general psychology to the shoddy doctrines of occultism were it not for the fact that such beliefs may overthrow with a single word the observed facts and the explanations that have been gained by a studious and sometimes painful devotion to the cause of science. The taste of people runs so much to the irregular that even the physical sciences have come to be known in popular opinion by their unusual aspects instead of by that large body of sound doctrine which is so attractive to serious persons. It is worth while anywhere and at any time to affirm that the main business of psychology is not to speculate about the ultimate nature of the soul, about supernatural conceptions of life and of death, about the magical effect of the stars and of other bodies upon human character and upon the future of the race, about the quickest and most extravagant way of reading character, the newest dream, our neighbor's premonitions, or our dog's telepathic ability. Psychology is interested in a sound, healthy mode of analysis of intelligence. The mental life it knows is a mental life that operates according to the law and order common to the rest of the universe. Psychology is not engaged in the business of keeping up primitive magic and superstition. Most occult beliefs and practices have only one value for psychology. We shall point out at the conclusion of this chapter that many of the events that are alleged to be occult depend, as a matter of fact, upon a normal exercise of the perceptive functions, but under conditions that are easily misunderstood. That is to say, the occult has served the purpose of forcing the psychologist to scrutinize more closely than he might otherwise have done the conditions under which the intellectual functions operate and the materials that they use. Otherwise, occultism makes no contribution to science.

Theosophy.—Occultism takes, as we have said, many forms. It includes the search for oil and for water by use of divining rods, the tricky readings of the past and of the future by using crystals, the belief in ghosts and apparitions, the practice of alchemy and of astrology, and many other forms of "mental dissipation." Three types of occultism we shall review more at length. They are theosophy, spiritualism, and psychic research. Theosophy, in its current form, was made popular by Mme. Blavatsky, a Russian woman of passionate temper and erratic disposition. After a few months with her husband she departed, still a young girl, to seek her own fortunes in the world. In India, in Egypt, and in our own country, she sought out the "mental dregs" of the day. Wherever she could she learned of Hindu mysteries, thaumaturgy, Indian medical practices, and Negro Voodooism. Finally she developed "psychic abilities" on her own account. In her presence weird rappings occurred and objects took on mysterious movements. In 1873 she reached New York and announced among spiritualistic friends her ability to see through and beyond such physical manifestations, "the operations of her theosophic guides in astral projection." In 1875, in conjunction with a Colonel Olcott, she founded the Theosophical Society. She initiated prospective believers into a secret system of Hindu super-wisdom and finally caused to be erected at Adyar, in India, a shrine from which issued mysterious answers to questions and letters. Her activities at this shrine, however, were found to be the result of planned collusion and for a while her doctrine declined in popularity; but after her death in 1891, others took it up and Theosophy became an art of mystic discourses with Karma and Maya and Nirvana, "communion with the higher ends of life, the cultivation of an esoteric insight" and of the ability to see with supernatural eyes the past, the present, and the future.

Spiritualism.—Spiritualism is another form of modern occultism. It sprang out of the desire to establish the reality of communication with departed spirits, but rests also upon a "systematization of popular beliefs and superstitions, modified by echoes of religious and philosophical doctrines. In 1848 two sisters,—the Fox sisters,—set the mental dreamers agape by mysterious rappings which seemed to be intelligently guided and ready to appear at call." Although séances with such phenomena as "levitation," "cabinet performances," "slate writing," "spirit messages," find counterparts in almost every century of our era and among all primitive peoples, the "spiritual" significance of such phenomena had, until the middle of the last century, been overlooked. More recently "spirit photographs" have been added to the list. The fact that the Fox sisters possessed toe bones which were easily dislocated and which were presumably the source of the "mysterious" knockings was not considered. Within a short time thousands of "spirit circles" sprang up and "mediums" began to display wonderful ability in getting into communication with the "dead."

The kind of data which spiritualists use may be gleaned from two or three of their own illustrations of alleged supernatural phenomena. In the paternal home of John Wesley, for example, the most extraordinary noises were heard in various parts of the house and no cause for them was ever discovered. Knocks, creaks, and crashes, as of broken crockery, were heard by many of the family. Upon one occasion Mr. Wesley's trencher danced upon the table without anyone touching it and door latches were frequently lifted although search failed to find any person near at hand. Mr. Wesley himself was several times pushed with something invisible. In 1883, at Worksop in England, basins and other objects sailed about, often in an undulatory fashion, as if in the control of spirits. No cause could be discovered. Eleven witnesses were summoned, and the walls and ceiling of the house were examined for any trace of mechanical means of producing the occurrences; but nothing was found. In a store at Turin in 1900, bottles were seen to roll about or lift themselves out of racks and fall. In most cases of this kind, the objects moved as though "they were borne along gently on undulatory waves." No one was ever able to seize these objects while in motion.[1]

Phenomena of this sort are produced regularly, of course, by every medium. One of the most famous of mediums was Eusapia Palladino, a Neapolitan peasant woman without education. She never learned, it is said, to write more than her own name. While quite young she became a servant in a family given to spiritualistic practices and, one day, she was found to possess, on her own account, unusual mediumistic powers. In 1892, in the presence of a number of eminent scientific men, and in full daylight, she was able to produce levitations of a table, inexplicable movements of other objects, and alteration in her weight; and in darkness, she was able to make hands appear which touched the observers. Although many of her performances were shown to be the result of her own muscular efforts, it was believed, nevertheless, that most of the things she did indicated supernormal powers.

In 1908, a special committee examined Eusapia. To quote: "Sometimes Eusapia would hold out her hand (held by one of the investigators) towards the curtain, which would then balloon out towards her in a round bulge. This also happened when one of the investigators held out his hand at her request. The bulge collapsed when touched. Noises inside the cabinet were frequent, the guitar-strings were plucked, the sounds synchronising with increased pressure or pinching by Eusapia of the hand of the investigator, thus indicating, as many other phenomena indicate, that there is often some connexion, though a supernormal one, between muscular effort on the medium's part and the phenomena that occur. Sometimes the objects within the cabinet would be brought out and placed on the séance table by unascertainable means, and touches were felt as if by fingers, on the arms, shoulders, heads, etc., of the sitters, in good light, without visible cause. In the darkness of the cabinet a greater degree of materialization was effected, and a hand with apparently living fingers could be felt through the curtain, Eusapia's hands being outside and fully visible. Sometimes a visible hand came from behind the curtain carrying one of the objects placed there; and at other times a head would appear, while the medium was in full view and in a fair light. On two occasions a cold breeze was felt, apparently issuing from a place on the left of the medium's brow. All three of the investigators felt it, and it was not altered when one of them held his hand over her nose and mouth. And to show that fraud alone is an unsatisfactory theory, it must be mentioned that raps, and the ringing and movement of a bell in a cabinet, occurred when Eusapia was not there at all, but apparently as a result of her 'fluid' or influence left behind after a visit."

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[1] Read Carrington, H., *The Physical Phenomena of Spiritualism*, 1908.

The samples are enough to indicate the kind of information and the sort of performance which gains credence among spiritualists. In spite of the fact that fraud is frequently discovered, and in spite of the fact that even Eusapia was detected and completely exposed, the belief has continued to grow that spirits from the other world are striving to make themselves known by the trivial means we have illustrated. The war has done a great deal to strengthen the belief that man will ultimately be able to converse with the spirits of the dead; for out of the trenches and from the homes which mourned the dead a vast number of stories have come affirming the existence of spirits that can and do give solace or warning. It is too early to predict where the movement will end; but the dubious conditions surrounding alleged spirit visitation and the careless manner in which the observations are made have failed to convince most critical observers of the reliability of the reports.

Psychic Research and Telepathy.—The presumption that the spirits of the "dead" may be striving to acquaint their earthly friends with the lives they lead in the other world has given material impetus to another kind of occultism, viz., telepathy. Telepathy has been defined as the transference of knowledge from one mind to another without the aid of the ordinary channels of sense. In a certain sense, telepathy is a focal problem in psychic research and spiritism, for it is agreed that, if communication between minds can be established, the other contentions of this branch of occultism can be easily established.[1]

To the end that relevant material might be gathered in one place and published and that the material itself might be selected under more critical conditions, there was founded in Great Britain in 1882, a Society for Psychical Research, for the purpose of "making an organized and systematic attempt to investigate various sorts of debatable phenomena which are *prima facie* inexplicable on any generally recognized hypothesis." The Society undertook work with respect to the following five problems:

1. An examination of the nature and extent of any influence which may be exerted by one mind upon another, otherwise than through the recognized sensory channels.
2. The study of hypnotism and mesmerism, and an inquiry into the alleged phenomena of clairvoyance.
3. A careful investigation of any reports, resting on testimony sufficiently strong and not too remote, of apparitions coinciding with some external event (as for instance a death) or giving

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[1] Read Crawford, W. J., *The Reality of Psychic Phenomena*, 1919.

information previously unknown to the percipient, or being seen by two or more persons independently of each other.

4. An inquiry into various alleged phenomena apparently inexplicable by known laws of nature, and commonly referred by Spiritualists to the agency of extra-human intelligences.

5. The collection and collation of existing materials bearing on the history of these subjects.[1]

The earlier days of the Society were spent with accounts and discussions of experiments on hypnotism and thought-transference, the latter faculty being held at that time as established. Many reports on apparitions, haunted houses, premonition, automatic writing, crystal vision, spiritualism, and multiple personality have filled the pages of the Proceedings of the Society. The Society has enjoyed a rapid growth and at the present time it includes in its large membership a considerable number of English men of science. An American Society was founded some years later, and it likewise has published its proceedings and numbers among its members persons of reputation in many fields. Elsewhere on the continent the movement has been of long standing. Fechner was looking toward a comprehensive formula of psychic and physical relationship rather than toward a study of talents of a person to make fine discriminations among the objects of his environment. More recently a distinct name (parapsychology) has been given to this department of research and many men on the Continent and in this country are of the opinion that parapsychology has become a legitimate branch of the psychological sciences.

In spite of incessant reports from various societies and individuals of incidents and even of experiments which prove, as they allege, the fact of "mental telepathy," the majority of reputable men of science are far from being convinced. At the time of Sir Oliver Lodge's tour of this country in behalf of such occult phenomena, a statistical investigation, receiving wide publicity, revealed that very few well-trained men believed that anything like satisfactory evidence had been presented.

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[1] *Brit. J. of Psychical Res.*, 1882, Vol. 1, pp. 3–4.

The Evidence for Telepathy.—What, then, is the evidence for telepathy? It comes, apparently, from two distinct sources. In the first place, a large number of individuals have experienced what is known as "the feeling of being stared at." Others have had premonitions and have even experienced hallucinations which were interpreted as visions of the dead appearing in the form of spirit-bodies. That is to say, common sense, in its tales and fictions, has accumulated a very large amount of material concerning the topic we are discussing. As we have suggested, it has been the duty of various societies of psychical "research" to trace such stories and to find out, so far as possible, all the facts surrounding the mysterious occurrence. As the movement has grown, many events of mysterious nature have been reported where every effort has been made to get as many witnesses as possible and where all the details of the occurrence have been, professedly, verified in a critical fashion.

In the second place, a great deal of evidence for telepathy has come from individuals who are professional mediums and who allege that they have direct contact with the world of spirits and also with the minds of the living who dwell at a distance. There probably are, at the present time, thousands of mediums in this country. Although many of them are deliberate frauds, a considerable number are no doubt convinced of their own ability to carry on communications which are not based upon the ordinary operations of sense-perception. From the accumulation of anecdotes and from the performances of mediums, then, has come the bulk of evidence in favor of telepathy.

It must be admitted that most of this evidence in favor of telepathy is gained under conditions that cannot be very well realized in the scientific laboratory. Much that has been done on this problem in the laboratory has been questioned by the psychic researchers for just this reason. Probably one of the greatest objections to the movement is that the very nature of the problem, and the conditions which it involves, are opposed, or at least are not in sympathy with, the well-tried canons of science. If the history of science teaches anything, it is that so long as problems are kept out of the laboratory, or so long as they are stated in a manner that keeps them outside the jurisdiction of laboratory technique, they have remained insoluble.

Experiments on Telepathy.—We shall turn immediately to the most ambitious laboratory efforts that have been made to answer the questions proposed by telepathy. Several years ago a sum of money was given to Stanford University for the establishment of a laboratory to be devoted to the problems of psychic research. A competent psychologist took the problem in hand and immediately began a long series of experiments upon telepathy. These experiments have set a reputable standard for investigations of the kind and they have exerted considerable influence among critically-minded individuals.[1]

The experimental problems fall into two classes: (*a*) those directed toward the fact of telepathic communication, and (*b*) those directed toward hitherto unknown but entirely normal means of communication.

Experiments on Guessing.—In one series of experiments upon telepathy a subject was put into a comfortable chair and instructed to make himself as passively receptive as possible. Behind him and facing him sat the experimenter with a box full of lotto-blocks upon which were printed two-place numbers from ten to ninety. As the experimenter drew out a block he would, under the conditions of the experiment, either visualize, or "think," in kinæsthetic or in auditory terms, the number appearing on the block. He did this with the intent to bridge the gap between himself and the subject and impress upon the subject, if possible, the number appearing on the block. After a limited period the subject reported the number if he could do so. One thousand trials were made; but the number of right guesses was not beyond the experimental and theoretical probability. The subject reported many experiences in which he was certain that he had guessed the right number; but as it turned out he was certain in about as many wrong guesses as in right guesses. Neither was the imagery by which the number appeared to the subject identical with that used by the experimenter in endeavoring to impress upon the nervous system of the subject the proper number.

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[1] See Coover, J. E., *Experiments in Psychical Research*, 1917.

Similar conditions obtained when 100 subjects underwent 10,000 experiments on guessing the suit of playing cards. One thousand additional experiments were made with psychic "sensitives." In none of these experiments was the number of correct guesses greater than chance would have produced. Some of the "psychics" testified that they had had messages or impressions from their spirit controls, but such occasions were in no way related to the correctness of their guesses. In the experiments on the feeling of being stared at, there was again, in 14,500 experiments, no more than a chance average that any individual knew he was being stared at either by one or by twelve individuals.

The Source of "Correct Guesses."—The most significant part of these experiments relates to the information gained concerning the kinds of perceptual processes occurring during the attempted telepathy. It was found that the subject could keep himself so receptive that imaginal material frequently appeared to bear objective meaning. The feeling of certainty usually rested upon the clearness and the behavior of the imagery used by the subject. The imagery was ordinarily visual and frequently appeared suddenly in consciousness. Occasionally an individual would report an unanalyzable feeling; but there is every reason to attribute such feelings to the inability of the subjects properly to analyze their experience. Some of the imaginal material was so clear and so thoroughly objectified as almost to approach the level of an hallucination.

Where the mediums who were sensitive to "psychic waves" were able to report in analytical terms, it was discovered that they used the same sort of imaginal material and that their judgments were usually based upon the same sort of clews as those used by the normal subjects. It was clear, however, that the psychics were able to become passively receptive much more easily than the unpracticed observers and it is altogether probable that their experiences, while in this state, were much clearer and more significant than is the case among the more naïve subjects.

The net results of the experiments on the transfer of thought and upon the feeling of being stared at are decidedly negative. They would seem to indicate that such knowledge depends upon certain feelings of assurance which in turn depend upon the clearness of the mental processes present. But these mental processes are not related in any significant manner to the actual facts of staring or to the attempted "projection" of the number on the card.

Subliminal Stimulation.—The second class of experiments had to do with unusual means of communication and with communication under unusual circumstances. A great deal of work has been done in the psychological laboratory on the nature and importance of "subliminal" stimulations or stimulations just inadequate to condition a reaction. There are, of course, wide differences in the clearness value of the processes making up the stream of consciousness at any particular moment. Some of these processes are very clear; but others are exceedingly obscure. It does not follow, however, that these background processes may not materially affect judgments. Again there is no doubt but that the neural processes set up by genuine "subliminal" stimuli are in all respects similar, save in intensity, to the neural processes underlying perception. That is to say, there are experiments which seem to prove that "subliminal" excitations will ultimately make it possible for the original excitation to come into full consciousness. In either of these cases, judgments might be profoundly altered or meanings appear at the focus of consciousness without any relevant antecedent, especially if the person were in a passive condition at the moment. If this is the case, there is every reason to suppose that "telepathy" is habitual in ordinary human intercourse, and that its essence consists in nothing more mysterious than the conditioning of mental processes which are at first too faint to establish themselves clearly in consciousness.

In the same way some stimuli may not bring about overt movement but they may occasion incipient movements and conduce to postures and attitudes favorable to a later overt response.

Experiments on subliminal impression are frequently performed by means of some exposure apparatus which will present more or less complex material within a time limit too short for adequate apprehension. By arranging the conditions properly it becomes possible to express numerically the amount of information that can be obtained under "subliminal" conditions.

Mental Habit.—It is frequently reported in the journals of the psychic research societies that experiments on card guessing or other experiments of a similar nature give a higher percentage of correct guesses than mere chance will acount for. In explanation of these assertions, experiments on "mental habit" have been suggestive. By turning to estimates of time or of age, for example, it appears that individuals have a tendency to estimate in round numbers. Judges, in giving sentences, use some periods of time far more frequently than chance would account for. That is to say, they have fallen into a verbal habit and the choices they make of a given sentence far exceed the choices that would appear in a normal distribution curve or that would be demanded by a chance distribution. Now it appears that if two individuals with about the same mental habits fall together in experiments of the kind mentioned above, a higher correspondence between guesses and the actual facts would be secured than that for which chance might account.

Assimilation and Associative Filling-in.—Further experiments have had to do with sound assimilation. It is a common experience, of course, to miss much that is said over telephones, in the dictaphone, from a phonograph, and beginners in new languages fail to understand a foreigner when he is speaking, not necessarily because they lack a vocabulary, but because the sounds that come are not thoroughly assimilated by a "prepared" nervous system. It has been discovered that 51 per cent of the sounds coming from a dictaphone may be lacking and yet the English language may be well understood. Thirty-three per cent of the sounds from a telephone and 23 per cent of the sounds from the human voice at a distance of 25 meters may be lacking and yet an observer be able to understand what is being said. Evidently there is in these cases a good deal of filling in. The amount of *sensory material* that may be absent is considerably less if the material listened to is nonsense material or is highly unfamiliar to the observer. The facts are sufficiently clear, however, to make it evident that inadequate sounds may often be filled in associatively and so be made to carry meanings which may or may not correspond to the facts. There are a number of other accessory ways by means of which we get information concerning the world about us, ways which, at the same time, run their course at such a low level of attention that it is almost impossible to describe the sources from which our knowledge comes. That is to say, there is a great deal of background organization and filling-in which may take place and lead to complex modes of thought without direct antecedents appearing at the focus of consciousness. Behavior patterns, both verbal and manual, may also appear without antecedent preparation or warning

On the whole, science has been unable to find any direct evidence for the existence of a mode of communication that depends upon sense organs other than those ordinarily used in communication. On the other hand, several obscure means of communication have been discovered that are entirely adequate to explain the facts that have been gleaned so far from the unusual experiences reported by alleged mediums and their victims. Lack of knowledge should never be an excuse for unbridled speculation.

Attitude of Scientific Men Toward Telepathy.—As a rule, men of science are apt to take a rather skeptical attitude toward all of the phenomena alleged to be "psychic." Very few of them would, of course, be so narrow-minded as to deny emphatically and without considering future research the absolute non-existence of any such mode of communication. On the other hand, the laboratory man is jealous of his critical-mindedness and he sees in the belief in telepathy a temper of mind that is not compatible with the scientific spirit. His chief general criticism of all of the forms of occultism which we have discussed lies, probably, at this point. Occult doctrines are, of course, accepted by some of his fellows. But science as well as common sense may sometimes go wrong. For example, before 1904 and after 1909 nothing was published in Science Abstracts on "n-rays." But in 1904, seventy-seven articles were published, with eight in 1905, three in 1906, one in 1907, none in 1908, and one in 1909. In 1904, a Professor Blondlot, an eminent physicist of Nancy and a correspondent of the Academy of Sciences in the place of Professor Helmholtz, announced the discovery of the "n-ray." These rays emanated, it was said, by solar radiation and from bodies in which they happened to be stored.

Many scientists "confirmed" the observations of Blondlot and attempts were made to apply the discovery to almost every known branch of science. Many others doubted the facts, however, and more critical observations failed to reveal the phenomena. It finally appeared that the n-ray owed its origin to unrecognized psychological errors of observation. Such a mistake in science means that even the attention of critical men is no guarantee of the genuineness of observed phenomena. There may be, in any given case, unrecognized mental sources of error in observation that only an appeal to experimental psychology can discover. This is illustrated by a great many of those chemical analyses which depend for their accuracy upon the comparison of colors. In determinations of hydrogen ion concentration, for example, the color of the solution to be tested is compared with a standard, that is, with an indicator. The accuracy of the method depends upon the sensitivity to colors of the experimenter and it often happens that inaccuracies from this source can be eliminated only after the experimenter has taken account of the frailties of his own perceptual apparatus.

Sources of Occultism.—Occultism derives from several sources. There is, in the first place, the human awe of the mysterious. Even many of the higher animals are curiously fascinated by new or novel objects. Like the person who gets a "pleasantly unpleasant" tingle from a wound nearly healed, we experience an inviting yet disconcerting satisfaction, a feeling compounded of pleasure and of uncertainty from unknown objects and events. Even objects and performances that savor but faintly of mystery or of uncommonness seize hold of us in a manner out of all proportion to their real significance. Such experiences are often distinguished by a characteristic bodily set and by an affective coloring that does not belong to ordinary experiences. In other words, unusual objects or events get themselves attended to. The spicy thrill of a good ghost story, the creepy contemplation of a trip through a graveyard at night, the zest of the latest novelty in the way of a dream, or the relish of a visit to the insane asylum are experiences that stand apart in our affective lives. The origin of the alleged "feeling of mystery" is doubtful. By some it is supposed to be a product of an organically based dislike for the infrequent or the unknown. Others relate it to an instinctive fear or awe. Still others appeal to the residues of previous individual and racial experiences with the unknown. Whatever its origin, the feeling has been played upon and augmented in popular belief until it stands in the way of any sober-minded attempt to deal with unusual topics. Those who have capitalized our regard for the irregular by gathering together and displaying, in the form of a circus or a company of entertainers, all the curiosities, prodigies, and eccentrics they can discover, do much to perpetuate the unfortunate consequences of mystery-worship and of occultism.[1]

In the second place, there is the tendency on the part of mankind to seek short cuts, or easy ways to a goal. This tendency lies, apparently, at the basis of his unreasonable "hunger" for speed in travel and in communication. A history of the development of man might be written in terms of the methods he has used to deal, in a shorthand manner, with the world. This tendency might even be said to have a biological or evolutionary basis, for distance or telepathic end-organs were greatly superior to the contact senses. The development of tools illustrates successive stages in man's ability to handle objects more rapidly and easily. Gestures gave way to words, and substantive words have given way to concepts. Drawings gave way to writing and writing to shorthand. But even these modes of communication are cumbersome and slow. The immediate appearance of knowledge in the "mind" of one individual by the "mental efforts" of another would be a tremendous advantage in our social, industrial, and educational activities. The long and tedious acquisition of knowledge by the process of education would take on a new significance if such a foreshortened or abridged mode of communication could be discovered and made universal.

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[1] Read Houdini, H., *A Magician among the Spirits*, 1924.

Many other motives might be mentioned, such as the desire to exercise control over other men; but the motive having the most influence is probably the desire to arrive at a scientific demonstration of immortality. A scientific proof of immortality is one of the fondest dreams of the race, and of all of the attempts that have been made, telepathy has been the most promising and, at the same time, one that came nearest to the experimental laboratory. In telepathy no assumption need be made concerning the nature of life after death if only it can be established that communications actually do come from individuals that were living and are now "beyond the veil." The psychic researcher urges that, if any mechanism can be discovered for conveying knowledge from one mortal mind to another, it will be of such an order as to function just as well in the life after death. Many of the hopes and fears of the race are bound up with the belief in immortality. It is obvious that the yearning of the living for continued companionship with the "dead" is a strong urge to put behind any theory of communication or any other scientific or "near-scientific" means of establishing continued life.

The belief in telepathy is further motivated by general religious beliefs. Many religions include in their tenets the belief that a personal God in some way immediately controls a man's life and that He may on occasion speak in person to a favored few. A great many individuals believe in the divine nature of conscience, "a voice in the soul whispering the commands of divinity." A growing knowledge of life and of the mechanisms upon which reactions are based have made it seem quite improbable to many others, however, that the human nervous system is equipped in a way to handle any such means of communication.

Conclusion.—A number of conclusions might be drawn from a chapter of this kind. It might be affirmed, for example, that the failure of occult practitioners to furnish any indubitable proof of the genuineness of their observations is sufficient reason for throwing the whole matter out of court. Again, one might give way to a certain degree of emotionalism, disregard the general spirit of scientific inquiry, and insist that although the facts have not yet been gained, nevertheless they *will* be discovered. Or yet again, we might follow certain contemporary writers and insist that the facts are already known and that the failure to accept them is but a sign of moral and spiritual cowardice.

We shall, however, summarize in still another way. It seems, from the account we have given, that occultism is a dangerous frame of mind, for it tempts its possessors into uncritical judgments of events. It may turn out, of course, that science is so rigid as to be unable to make room for methods adequate to the unique kind of material occultism postulates. That is to say, current scientific methods may be genuinely inadequate to treat of "souls," "psychic forces," and so on. The history of science seems to suggest otherwise. The problem, then, is essentially an experimental problem directed toward the perceptual functions. It is not a problem that can be solved by appealing to anecdote or to religious emotions. The laboratory has been a faithful servant and there is no reason to reject it at this time. So far, its conclusions regarding these problems have been negative.

CHAPTER XVI

HYPNOSIS

The shortest introduction to the facts of hypnosis lies in a brief sketch of the ways in which men have formerly treated these facts. We have described in another place those states of partial insensibility and of trance which, produced now by drugs or again by primitive hypnotic methods, make up so large a part of savage magic, witchcraft, and exorcism. These facts are of interest, naturally, to the student of hypnosis but modern scientific interest in the problem has come from an entirely different source.

Historical Notes.—It was Paracelsus, a Swiss physician of the 15th century, who gave the first definite expression, in modern times, to the facts which were later to fall under the term "hypnosis." He developed, so the records say, a system of medical treatment based upon the assumption that the stars and certain other bodies, including magnets, possess a peculiar fluid or emanation which, when directed toward the human body, has a powerful remedial influence upon it. This fluid was supposed to pervade all space; but the locus of its effect lay primarily in such objects as the stars and magnets. Upon this theory, Paracelsus built up a large medical practice and he was able, apparently, to cure a good many diseases by manipulations which were alleged to involve this peculiar substance. A hundred years later a man by the name of van Helmont affirmed that this fluid was to be found even in the human body, and that by an act of will it could be made to influence other individuals.

These crude conceptions were accepted by a very great number of people and it was not long before the beliefs had spread throughout the European continent and to England from whence they were shortly afterward carried to America. During the middle of the 17th century, an Irishman by the name of Greatrakes performed many miracles of healing in England by professing to use some subtle power or force. It was said of him "that God had bestowed upon Mr. *Greatarick* a peculiar Temperament, or composed his Body of some particular Ferments, the *Effluvia* whereof, being introduced sometimes by a light, sometimes by a violent friction, should restore the Temperament of the Debilitated parts, reinvigorate the Blood, and dissipate all heterogeneous Ferments out of the Bodies of the Diseased, by the Eyes, Nose, Mouth, Hand, and Feet." [1]

These doctrines and medical practices grew in popular favor and in traditional value until, in the hands of Mesmer, elaborate séances began to throw the whole of Paris into a fervor of excitement. Mesmer (1733–1815) was an Austrian physician whose early interest lay in astrology. He wrote his doctoral thesis on the relation between the stars and human conduct. He was influenced in his work by a man by the name of Gassner who had had considerable success in healing diseases by making passes over his patient. Mesmer adopted the same method. He appealed directly to an occult force which could be stored up in objects by proper manipulations and thus transmitted from one place to another. He believed that this substance permeated the universe but that it adhered especially to the nervous system. About 1778 he made a tremendous stir in Paris by mysterious performances carried out in a dimly lighted suite of rooms full of mirrors and to the accompaniment of soft music. His patients sat around a vessel containing a variety of chemicals and at appropriate intervals Mesmer himself would appear on the scene in the dress of a magician and make mysterious passes in the air with his hands. The healing fluid was supposed to emanate from Mesmer's body into the vessel or storage battery which he had prepared.

In 1784 a commission from the Paris Academy of Sciences, of which Lavoisier and Franklin were members, reviewed the work of Mesmer and while they were convinced of the effects he induced, they failed to be persuaded of the magnetic influences of his body.

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[1] Jastrow, J., *Fact and Fable in Psychology*, 1900, p. 177.

A pupil of Mesmer's was the first, apparently, to observe a genuine case of what came, finally, to be known as a state of hypnosis. On the fourth of May, 1784, Puységur, the pupil, says that he had magnetized a subject, Victor, in the usual way, when he was surprised to see that, at the end of a quarter of an hour, the subject was sleeping peacefully in his arms without convulsion or pain. He spoke, and seemed occupied with his own thoughts, which were apparently unpleasant. Puységur suggested pleasanter ones and found that the subject became happy, imagining that he had drawn a prize at a fête. Puységur was able to make his subject dance on a chair as if to a melody. Upon awakening, the subject remembered nothing of what had happened. Puységur thus came upon what may be considered "as the first clearly recorded and uncomplicated production of the condition which made possible the study of hypnotism."

Political and social conditions interfered, for a time, with the growing movement and it was not until 1841 that further progress was made. Only one practitioner became of significance during the interval, a man by the name of Bertrand, who insisted that Mesmer's phenomena were due, not to some magical force, but to certain physiological and psychological factors, mentioning among the latter "suggestion." The prejudice toward belief in a magnetic fluid was too great, however, and Bertrand was forgotten. But in 1841 James Braid, an English surgeon, was impressed by the demonstrations of a traveling "mesmerist," and, in subsequent studies in the field, came upon the work of Bertrand. He reaffirmed Bertrand's doctrine of suggestion and would probably have placed the whole subject upon a sound basis, medical and psychological, had it not been for two events. One of these was the discovery of the anæsthetic properties of ether and of chloroform, and the other was the revival of spiritualism. Hypnosis had found a legitimate place in certain French hospitals, where it was used as a curative agent and for the production of anæsthesia during minor surgical operations; but the discovery of the surgical value of ether and of chloroform displaced hypnosis and the tradition behind the hypnotic trance made it fall readily into the questionable practices of the spiritualists.

The more recent history of hypnosis has been made, for the most part, in the psychopathic hospitals. The value of the treatment in cases of mental disturbance was too great to permit interest in the phenomena to die out. Charcot in his hospital in Sâlpetrière completely reinstated the facts as they had been discovered in the years preceding, and used hypnotic methods with great success, especially among hystericals. In fact, he even came to the conclusion that hypnosis was a symptom of the morbid condition known as hysteria. In 1884, however, Liebault and Bernheim at Nancy developed the suggestions formulated by Bertrand and Braid and insisted that hypnosis was only an exaggerated form of a mental state common to all experience. They urged that "suggestion" was also a common experience and that heightened suggestibility was only one of the symptoms of the hypnotic condition. It is now recognized that Bernheim had come closest to the actual facts and that while the physiological conditions underlying the production of the hypnotic consciousness are not fully known, it is certain that the events are not the expression of a magnetic influence or other emanation passing from one body to another.

Absent-Mindedness.—We begin with a simple experiment. "And Crito made a sign to the servant; and the servant went in, and remained for some time, and then returned with the jailer carrying the cup of poison. Socrates said: You, my good friend, who are experienced in these matters, shall give me directions how I am to proceed. The man answered: You have only to walk about until your legs are heavy, and then to lie down, and the poison will act. At the same time he handed the cup to

Socrates, who in the easiest and gentlest manner, without the least sign of fear or change of color or feature, looking at the man with all his eyes, as his manner was, took the cup and said: What do you say about making a libation out of this cup to any god? May I, or not? The man answered: We only prepare, Socrates, just so much as we deem enough. In answer, he said: yet I may and must pray to the gods to prosper my journey from this to that other world—may this, then, which is my prayer, be granted to me. Then holding the cup to his lips, quite readily and cheerfully he drank off the poison. And hitherto most of us had been able to control our sorrow; but now when we saw him drinking, and saw too that he had finished the draught, we could no longer forbear, and in spite of myself my own tears were flowing fast; so that I covered my face and wept over myself, for certainly I was not weeping over him, but at the thought of my own calamity in having lost such a companion. Nor was I the first, for Crito, when he found himself unable to restrain his tears, had got up and moved away, and I followed; and at that moment Apollodorus, who had been weeping all the time, broke out into a loud cry which made cowards of us all. Socrates alone retained his calmness: What is this strange outcry? he said. I sent away the women mainly in order that they might not offend in this way for I have heard that a man should die in peace. Be quiet, then, and have patience. When we heard that, we were ashamed, and refrained our tears; and he walked about until, as he said, his legs began to fail, and then he lay on his back according to the directions, and the man who gave him the poison now and then looked at his feet and legs; and after a while he pressed his foot hard, and asked him if he could feel; and he said, No; and then his leg, and so upwards and upwards, and showed us that he was cold and stiff. And he felt them himself, and said: When the poison reaches the heart, that will be the end. He was beginning to grow cold about the groin, when he uncovered his face, for he had covered himself up, and said (they were his last words)—he said: Crito, I owe a cock to Asclepius; will you remember to pay the debt? The debt shall be paid, said Crito; is there anything else? There was no answer to this question; but in a minute or two a movement was heard, and the attendant uncovered him; his eyes were set, and Crito closed his eyes and mouth.

"Such was the end, Echecrates, of our friend, whom I may truly call the wisest, the justest, and best of all the men whom I have ever known."

If now, the reader will run back over the events of the last few minutes he will find that mental organization has undergone rather significant changes. We shall suppose that mental life was, for the time being, running on without any definite temporal organization. As the text was picked up and opened, say to this particular chapter, the act of picking it up and the perception of the printed page were, presumably, but a limited part of all the objects being attended to at the moment. A large number of processes may have been running their several courses, and constant shifts in prepotency probably established now one object and now another in the whole range of apprehension. Some of the processes may have referred to the task just finished, others to the coming day or to the appointment of the evening, still others to objects in one's own room, and perhaps a few to the assignment that had to be covered for the next day. In other words, the stream of experience was fairly wide and a large number of objects were probably being entertained at various levels of clearness at about the same time. But as the chapter was begun, it may be remembered that some of the processes began to get less clear. Many of the memory afterimages left over from experiences occurring just previous to taking up the text dropped out. In retrospection one may observe oneself as one became more and more absorbed in the immortal story of the death of Socrates.

One can now see how it is that a limited group of processes may displace a large number that are already present. Perceptual material began to lose its prominence and before the end of the first page was reached, the imaginal processes carrying the death-room scene were almost alone in the whole field of consciousness. Cutaneous and kinæsthetic processes from holding the text, or from the position of one's body and clothing, noises from outside one's window, became very obscure. For some individuals who find in the paragraph we have chosen an appealing story of one of the world's greatest tragedies, the limitation of the field of consciousness may have proceeded to such an extent that the marginal or background processes practically disappeared. In other words, consciousness may have become at the end of the selection almost a single-level consciousness.

Under certain conditions the modification in mental organization which we have just described may proceed to still greater degrees. A person may become so absorbed in the story of Socrates that he may fail to hear his name spoken. He will sit in an uncomfortable chair or in a strained position for hours at a time reading a novel and find at the end of the period that he has no clear memory of what has taken place about him. The effective environment has been, during the entire period, a very limited environment where the events adequate to the process of reading the novel have shut out, by their very intensity, all other claimants to recognition, all other incentives to action or response.

We have, then, two words, concentration (extreme prepotency) and absent-mindedness, concentration referring to the singleness of experiences, absent-mindedness referring to the fact that the rest of the world passes by unheeded. A reader deeply immersed in his story may become extremely insensitive to objects and events round about, and his own body may be touched or moved without breaking into his "single-mindedness." Usually the absent-minded person (rather, the person who is too extremely present-minded) finds that he has scant recollection of what has been going on about him.

The Nature of Hypnosis.—In many respects hypnosis is identical with sleep. Sleep is by no means a period of complete quiescence, for most persons dream almost continually; recent experiments have shown that the amount of bodily movement during the sleeping period is really prodigious, and we know that persons often speak and walk in their sleep. In both sleep and hypnosis quiet is demanded, both require relaxation and distraction, and both may be easily interpreted in terms of the same behavior and neural facts.

We recall from the discussion of sleep and dreaming that the disappearance of consciousness may be attributed to changes in the resistances at the synapses, that is, to increased resistance due to fatigue or to habit or to some other unknown reason. Whereas during waking life the nervous system shows itself to be well organized, during sleep it appears to be disintegrated. Hence the bizarre nature of dreams. Neural patterns and movement systems come into odd relations with one another and thus we skate down the fire escape or chase the 69th horse which has escaped from our 70-horsepower motor car. Hypnosis, as we shall find, is characterized by heightened suggestibility. Just as our dream life may take up some stimulus, say the sound of the alarm clock, and weave around it a suitable but wholly illogical dream, so the hypnotized subject takes up a suggestion or a stimulus and responds to it in an equally irrational manner. The assumption that the nervous system is disintegrated during sleep and during hypnosis would account for both dreams and suggestibility.

The depth of sleep during the state of hypnosis is ordinarily shallower than during normal sleep, but now and again a patient may fall into a deep state of induced sleep which does not lend itself readily to distinction for ordinary deep sleep. A lightly hypnotized person will, if left to himself, go into an ordinary light sleep or nap, and in due course of time awaken as he would from any after-dinner siesta.

In spite of the many similarities between normal sleep and the hypnotic state there are certain differences which make it advisable to continue research in the field until the nature of both sleep and hypnosis are better known. A sleeper is rarely open to suggestions from another during the night; certain reflexes such as withdrawing a tickled foot are functionally active in sleep but not in hypnosis; sleep does not present the unique fact of posthypnotic suggestion. Of these differences the most significant is the *rapport* which obtains between the hypnotized subject and the operator. The sleeper is quite shut away from the events about him while the hypnotized subject may act as if aware of all that is taking place. A stimulus to which a hypnotized subject might react as he would in normal life may awaken a normal sleeper. Other stimuli are reacted to only in the sense that upon awakening the sleeper will report having had dreams which clearly show their relation to disturbing stimuli.

Method of Inducing the Hypnotic State.—Modes of inducing hypnosis are still governed by many traditions and half-magical beliefs and by practices used upon the stage in order to make hypnotic demonstrations impressive, and it is therefore difficult to distinguish conditions that are essential and those that are incidental. Usually, however, the patient is put into as comfortable a position as possible, he courts the idea of going to sleep and submits himself passively to the suggestions and commands of the physician. In order to promote sleepiness he may be asked to fixate some object, say the button on the physician's coat or some special object which the operator may have found useful in promoting lethargy. In the meantime the patient is reminded over and over again that he is becoming drowsy and that presently he will fall asleep. As a matter of fact the eyelids soon begin to droop and the patient falls into a condition that can best be called "light sleep." If the suggestions are continued the patient will become drowsier and drowsier, falling at length into a heavy sleep.

It appears essential then that the patient coöperate heartily with the physician if the state is to be induced. Lack of coöperation, suspicion, or active resistance on the part of the patient result in failure. There are times when a physician who has what we call "a strong personality" can overcome the resistance or suspicion of a patient with "weak personality" by impressive commands, mysterious passes, and a thousand and one other "tricks of the trade." A few people may be bullied into drowsiness, but where there is plenty of coöperation between patient and physician as high as 90 per cent of normal persons may be hypnotized.

The process of awakening is, naturally, the reverse of the process of going to sleep. The physician merely states that it is time to awaken, or suggests repeatedly that the subject will shortly awaken, and in a few moments the patient will actually throw off his drowsiness and begin his normal life much as he begins it in the morning after a good night's rest.

The Nature of Rapport.—The great difference, as we have found, between hypnosis and sleep is the presence of rapport between the subject and the experimenter. That is, the hypnotized subject is always open to suggestion from the experimenter and it will be instructive to ask about the nature and limits of this rapport. What can and will a subject do during the state of hypnosis?

We begin with the general observation that he will act in accordance with any proposition that is made to him providing this proposition does not run against fundamental instinctive tendencies or does not demand of him skill and strength beyond his normal powers. A normal person will not commit murder, theft, or rape during hypnosis. He will, however, say that he sees objects that are not present (hallucination), he will fail to see objects that are present (negative hallucination), he will play the part of Napoleon or any other suggested character so far as his knowledge of the character will permit, he stands, in brief, in a one-to-one relation with the experimenter. If told that he cannot walk and he is then asked to fetch an object from the other side of the room he will be unable to execute the command. Later, if he has any memory at all of such an experience he will report that he felt as though he could fetch the object if he wanted to, but the act of walking across the room appeared too strenuous. He had no inclination to move from his chair.

Suggestion.—If the analogies between the hypnotic state and sleep are truthful, that is, if hypnosis is a state of extreme dissociation or disintegration, then we may see into the mechanism of suggestion. The word suggestion seems to refer to the fact that an individual will often accept as true or accept for immediate action, any proposition that is made to him or any stimulus that is put before him, without having any logical grounds upon which to base either his acceptance or his rejection of the proposition, that is, without there being any particular facilitation or inhibition of the tendency to action issuing from the stimulus presented. In the simple experiment described above we should probably find that, while immersed in the story of Socrates, the reader would follow the command to move to another chair without hesitation and without interrupting the process of reading.

Amnesia Following Hypnosis.—Unless specifically commanded to be ready to report his experiences, a hypnotized subject will commonly fail to remember what has taken place during the state of induced sleep, although in a second state he may recall what took place during the first. It has been shown, however, that this amnesia is not complete since a little questioning and a little suggestion will enable him to recall many of the events that have occurred just as questioning and suggestion aid all of us in recalling events of yesterday or of yesteryear.

Posthypnotic Suggestion.—Posthypnotic suggestion is perhaps the most curious feature of hypnosis. If, during the period of hypnosis, the subject is instructed that at a certain time and under certain conditions he will act in a prescribed way, the instruction will be carried over into the posthypnotic period and at the designated time the individual will carry out the instruction without being able to assign any obvious reason for doing so. As the designated moment approaches he may betray a little uneasiness and if asked why he acted as he did he will say that outside of the impulse he can assign no other reason.

The General Intelligence of a Hypnotized Subject.—Among the common beliefs about hypnosis is the conviction that a subject is intellectually superior to himself during the state of hypnosis. Experiments show that a person, during hypnosis, is not moved by any superior powers or by any new type of intellectual talent. In deep sleep there seems to be some power better to resist fatigue and pain, and a better recollection of long forgotten experiences, but on the whole there is no noticeable difference between normal and hypnotic states so far as the ability to make discriminations, to learn and to recall, or to do physical work which does not involve fatigue is concerned. It has been commonly believed that hypnotized subjects have an abnormal sensitivity to contact. This has not been experimentally substantiated, although it does appear that light contact may issue in responses of more than ordinary intensity.

The Explanation of Hypnosis.—A great many theories have been constructed to account for the facts of hypnosis. We can dismiss at once any theory dependent upon animal magnetism or upon any sort of electric fluid. Charcot, the French physician, urged that the state was the result of abnormal physiological conditions, a conception which does not, however, agree with the facts. Others have alleged, in turn, that the conditions are due to exhausted peripheral nerves; to amœboid movements of the nervous tissue; to cerebral anæmia; to cerebral congestion; to the accumulation of fatigue products; to a temporary suppression of the functions of the cerebrum; to the independent functioning of one hemisphere; to the disappearance of normal consciousness and the reappearance of the dream consciousness; and, finally, to a permanent dual personality presenting the normal self, on the one hand, and an hypnotic self, on the other.

None of these theories explains all of the facts. On the contrary, many of them introduce new things to be explained. The state must undoubtedly rest upon some temporary state of nervous dissociation. At any rate it is much safer and much more satisfactory to refer to the nervous system, even in a general way, than to allege "effluvia" or magnetic liquids.

We shall be able to consider this matter more intelligently after we have read the next chapter on principles of explanation in abnormal psychology.

CHAPTER XVII

PRINCIPLES OF EXPLANATION IN ABNORMAL PSYCHOLOGY

The behaviorist, as we have seen, attempts to describe all of the facts of psychology without inserting at any time within the series of events from stimulus to response any type of mental process which can be said to be effective in determining what happens. The stimulus excites activity in the sense organ, this activity or excitation is propagated to a sensory area in the brain, thence to some association area, thence to the motor area, and finally to a muscle or to a group of muscles. This is said to be a closed circle.

Now the advocates of a psychology which is to treat of pure mental processes and events may argue in much the same way. Today we entertain an idea or enjoy a perceptual experience. After a short time the idea or perception has disappeared. In the course of a day, a week, or a month the idea is recalled. The question is asked: Does the idea or the perception or the thought disappear into nothing and is it then resurrected out of nothing? This, it is said, is inconceivable. Psychologically speaking, there must also be a closed circle of mental events. And the circle is said to be closed in the subconscious.

It is clear from this that the subconscious is not an observed fact. It is a theory. It was devised to explain events and occurrences which did not seem to lend themselves readily to an explanation by the known facts about mental life and especially about the nervous system. Our query, then, is directed upon the usefulness of this theory as a mode of explanation. The theory itself is one of the most brilliant and inviting theories which psychology has been able to produce. It does explain a great many facts; but one may ask whether psychologists are forced to devise any other theory before it is shown that more natural facts have completely failed.

Before we consider these matters we must have a clearer idea before us of just what is implied in the word "subconscious."

Common Uses of the Word "Subconscious."—The word "subconscious" has often been used to refer to the marginal or background processes of our mental life. It will be recalled from the discussion of psychology as a science of mental life (p. 83) that attention describes a state of mental organization in which some processes lie at the focus or at the level of greatest clearness, while many processes fill up the background and give meaning and color to the processes at the focus. In the chapter on mental telepathy we have found that these background processes may play a large part in influencing the character of the processes at the focus, especially when judgments are being made. In other words, there are a great many processes and process organizations in mind that we are not fully aware of at any given moment. Likewise there are many movement systems which lie outside the immediate field of reaction. These may, on occasion, exert a profound influence on the character of the processes of which we are aware or upon the movement systems that are under way. It has even been urged further that the background processes are the original "psychic stuff" from which have been formed the more sharply defined contents of consciousness.

James' Fringe.—James, for example, was probably entertaining some such notion when he spoke of the mind of a child as "a great big blooming, buzzing confusion." He asserts that it is out of this undifferentiated mental stuff that the discrete clear facts of more mature mental life are formed. This background is not merely a "reservoir of sensations" and other processes that are not attended to. "There seems to exist in this fringe all manner of latent and incipient impulses, attitudes, tendencies to reaction, partially suppressed feelings, wishes, and volitions." Now there is obviously nothing mysterious or impossible about such a conception of the "unconscious" or of the "subconscious," although the word "subconscious" is exceedingly inappropriate. This background region is certainly not under anything. It merely plays a peculiar rôle in the continuity of mental life. It furnishes body or substance to what otherwise might be discrete experiences. If our discussion of the subconscious could stop with a description of certain phases of the problem of attention the subconscious could easily be disposed of. There are, however, other more revolutionary meanings of the term.

"Unconscious Cerebration."—The word is sometimes used synonymously with the "unconscious" and is thereby identified with certain types of nervous activity. So far as our knowledge goes, mental life depends in large part upon what takes place at the cortical level. There are, however, lower levels upon which certain kinds of organization may be built without immediately affecting consciousness. Such organizations may ripen and indirectly condition organizations at higher levels. There may thus appear in experience, mental organizations without any observable mental antecedents.

As Herrick says: "Much of that which goes in psychological literature under such contradictory terms as unconscious mind or subconscious mind is, in reality, the subcortical elaboration of types of action systems which ordinarily do not involve the cortex at all, but which upon occasion may be linked up with cortical associational processes and then come into consciousness in such a form as to suggest to introspection that they are all of a piece with the conscious process with which they are related." [1]

If this should be proved, there are many events happening in consciousness that might be readily explained by appealing to the "unconscious" or the "subconscious." It is this possibility to which Carpenter referred many years ago when he devised the descriptive phrase "unconscious cerebration," and there is still no direct evidence that such neural functions may not take place.

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[1] Herrick, C. J., *Introduction to Neurology*, 1916, p. 309.

Here again, there is little in the "subconscious" to which objection can be made, for the term merely refers to a kind of activity in the nervous system. If the subconscious means neural operation there is nothing mysterious underlying normal consciousness.

It is altogether probable that the physiological psychologist will be able, some day, to describe quite fully the conditions under which such "subconscious" organizations take place. It is known now that excitations of the nervous system too small in intensity to rise to full consciousness or even to marginal consciousness may set or prepare the nervous system in such a manner that subsequent subliminal excitations can condition consciousness. Moreover, it is even possible to demonstrate the effect of controlled subliminal excitation on the character and clearness of mental processes. There is, then, considerable reason for hope that further information will be had concerning this sort of mental and neural organization. We shall attempt to show presently that theorizing upon the foundations suggested by neurology will be more profitable, in the long run, than theorizing where no experimental problems can be devised to support or attack the theory.

The "Psychic" Subconscious.—As we have suggested in the introduction to this chapter, those psychologists who adhere to a belief in "pure mental stuff" have no difficulty in thinking of this stuff as lying outside of immediate awareness. The neurologist suggests that most normal mental life is probably a function of cortical activity, and of much of this we are aware, but of subcortical activity we are not aware. There is no reasonable objection, however, to believing that subcortical activity is accompanied by conscious processes of which we may not be aware. There could, then, be a genuine "subconscious mind" conditioned by our own nervous systems.

Some psychologists go further than this, however. A nervous system, they allege, is only an incident to Mind. It is a rackety instrument which Mind has to use; but the real functions of Mind! they are wider and deeper and more significant than anything which appears above the mental horizon of the experiencing individual. This, in general, is the subconscious which is used as an explanatory principle in contemporary abnormal psychology.

Many analogies have been devised to illustrate the nature of this subconscious. Mental life has been compared to a great iceberg, of which only a fraction appears above the level of the sea. In this case, the visible part of the mass corresponds to normal consciousness while the great invisible bulk is analogous to the subconscious. Again mental life is likened to islands in the sea which are, in reality, connected below the sea level with one another. According to this analogy, the vast connecting links are the subconscious. The floor of the ocean and the islands represent, according to some writers, a great racial consciousness (it may represent even the Mind of God) of which small portions appear above the sea level as discrete or individual minds. The individual mind, then, bears a distinct relation to the mind of the race. For others, the subconscious is nothing more nor less than a great mental reservoir into which are dumped all the experiences of an individual. They are there preserved against the day when, for one reason or another, they may be drawn upon and used.

The Subconscious as an Explanatory Principle

We said above that the theory of the subconscious was devised to explain a number of facts that did not seem to fall readily under the categories of psychology as the science then stood. What are these facts? How does the theory relate to them?

Automatic Writing.—Let us consider, first of all, the facts of automatic writing. In normal life, it frequently happens that certain individuals will, while engaged in a conversation with another person, idly and without intent, draw diagrams or even write words upon a convenient sheet of paper. Sometimes the diagrams may include considerable detail, and it is not at all unusual for sentences and even paragraphs of a decently sensible nature to be written. In a few individuals this sort of performance may appear so consistently as to result in lengthy articles and even in novels. There is, for example, in St. Louis a Mrs. Curran who, a number of years ago, began to write automatically the impressions and poems of a hypothetical personage known as Patience Worth. A volume appeared under that name and since that time Mrs. Curran has written a number of other highly regarded volumes. In such cases it is quite easy to appeal to a subconscious out of which directions may come for writing and out of which may appear information and detailed content of the most baffling nature.

Explanation of Hypnosis.—In the second place, hypnosis has been explained by appealing to the subconscious personality. That is to say, an individual who has been hypnotized is alleged to expose, for the time being, his subconscious self, and under the influence of such an agent he is led to carry out a good many activities not possible to the normal waking consciousness. The subconscious thus explains the phenomenon of posthypnotic suggestion, the recollection of dreams and other events which have been forgotten, and a host of other facts of the same order.

Multiple Personality.—The facts of dual or multiple personality and many other mental disturbances are also alleged to owe their origin to the great unconscious psychic levels. The origin of a second personality was a rather baffling event until the facts of mental organization were known, and it was easy, therefore, to refer it to the appearance at the normal level of consciousness, of a group of subconscious mental processes that could take on, for the time being, the functions and character of a true personality.

Hallucinations and Dreams.—Hallucinations appear to be manufactured out of nothing and men never have been convinced that dreams do not somehow transcend time and place and put us in touch with another world. It is easy to assume that visions may be conjured up out of the subconscious, either by day as hallucinations or by night as dreams. This is particularly true of certain types of religious visions and of dreams which seem to carry prophetic import. There are no obvious reasons why a mother should not, at some time or other, dream the details of an accident to her child coincident with an actual accident. To attribute the coincidence to an intervening subconscious is, perhaps, the natural thing to do, but it is not a convincing thing to any one but the person who experiences the coincidence.

Crystal Gazing.—It is easy for some persons to close their eyes and yet "see." They see in their mind's eye. They are what we call visually-minded. Their memories have a tendency to appear in terms of visual processes. We may remark, too, that other individuals have preferences for auditory or tactual or kinæsthetic memories. We are interested primarily, however, in the visually-minded.

If, now, a person who is strongly inclined toward visual imagery gazes steadfastly but at the same time absent-mindedly into a glass of clear water his imagery will shortly be increased in vividness until he will believe that he is viewing a procession of events which is literally outside of him. This is the mechanism of crystal gazing. The professional crystal gazer chooses a round ball of glass or a highly polished metal ball and by augmenting the intensity of his visual imagery convinces himself that he is looking beyond this world into some other, perhaps the subconscious world. In this world he alleges that he can see the past and the future of other persons, for their subconscious is revealed to him through his crystal. When he is aided and abetted by trickery and by confederates in an audience he can put on a very creditable performance. The existence of a subconscious, he alleges, is the only explanation of his "remarkable" powers.

The Subconscious and Religion.—By far the most popular and the most impressive use of the subconscious has been made in behalf of religion. William James is largely responsible for the widespread currency of this practice. At the time he wrote, religion was hard pressed for a scientific approach to the problem of "divine guidance" and to the problem of the soul. In other fields the conflict between religion and science was being nicely resolved. It had been finally granted that the Bible was not a textbook on geology or biology; but until the publication of *The Varieties of Religious Experience* the conflict was at its height in the field of religious experience.

James took his departure from the assertion of a religious man that he has a *better nature* and that this better nature "*is coterminous and continuous with a* MORE *of the same quality, which is operative in the universe outside of him, and which he can keep in working touch with, and in a fashion get on board of and save himself when all his lower being has gone to pieces in the wreck.*"[1] James sought to discover a way in which humanity could be linked to divinity without at the same time losing sight of strictly scientific facts and principles. He sought to discover a bond of union between the religious experience of an individual and the source of that experience. He appealed to the subconscious for aid. He writes: "The *subconscious self* is nowadays a well-accredited psychological entity; and I believe that in it we have exactly the mediating term required. Apart from all religious considerations, there is actually and literally more life in our total soul than we are at any time aware of. . . . 'Each of us is in reality an abiding psychical entity far more extensive than he knows—an individuality which can never express itself completely through any corporeal manifestation. The Self manifests through the organism; but there is always some part of the Self unmanifested; and always, as it seems, some power of organic expression in abeyance or in reserve.' . . . Let me then propose, as an hypothesis, that whatever it may be on its *farther* side, the 'more' with which in religious experience we feel ourselves connected is on its *hither* side the subconscious continuation of our conscious life." [1]

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[1] James, W., *The Varieties of Religious Experience*, p. 508.

We now have enough instances of supernormal intellectual functions before us in order to understand what the theory of the subconscious has to accomplish. When we consider intuition, the solving of problems in our dreams, "hunches," and a large variety of other "normal" functions, our respect for the subconscious as an explanatory principle is still greater. And finally, when we recall all that was said in Chapter XIII about certain modern theories of "mental disease" we ought to have a genuine admiration for the theory.

Is the Theory Justifiable?—The theory of the subconscious has had a greater vogue in medicine than in experimental psychology. To the average experimentalist it seems more like an intellectual extravagance than a useful theory. On this account it is extraordinarily hard to criticize. There is no simple way to overthrow it either by logic or by demonstrating its internal weaknesses. It is, of course, not the kind of thing that can be brought into the laboratory. It is easy enough to affirm the existence of a subconscious mind and it does explain, in at least an *interesting* manner, many strange states and performances, but science never has been famous for making itself and its theories *interesting*.

Many psychologists believe, however, that the science should here use again its principle of parsimony, for they believe that the nervous system can and does operate in ways sufficiently elaborate and intricate (even if unknown) to account for all that the organism does. This conclusion takes us back to all that was said in Chapter IV about the modes of operation of the nervous system. The subconscious means, of course, that only a portion of the total activity of the nervous system is reflected in the course of experience. The appeal which all of the modern psychologies, and especially the introspective and analytical schools, make to determining tendencies, problem-bearing tendencies, and the like, is only one reflection of the fact that *subconscious* organization and incipient functioning is the rule rather than an exception. Herrick and others have said that consciousness is probably related to cortical activity more closely than to any other part of the whole system and yet below the cortex there are all kinds of correlating centers which might easily create action patterns and trends of mental life for which there is no obvious preparation. There may also arise a variety of bodily attitudes, or sets, which may be of the intuitive or the foreboding kind, but which have no significance beyond the fact that the whole organism is continually in some attitude or other toward new situations.

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[1] James, W., *Varieties of Religious Experience*, pp. 511ff.

To quote: "The interrelations among the neural patterns, the changing tensions within the patterns themselves, the facilitations and inhibitions that one pattern exerts upon another; these together with the conscious processes of association correlated with them are sufficient to account for much that has been attributed to the subconscious, such as the sudden solution of puzzling problems, the bursts of genius, awaking at a preëstablished time, and the shiftings of habit systems and memory systems. . . . Take for instance, the supposed solution of a puzzling problem during sleep. In the examination of the problem from all sorts of angles, many sets of associative connections, wrong patterns as well as useful ones have been established. There is interference among these associative patterns—the wrong ways of dealing with the various stages as well as the right ways are fresh in the mind, and the nervous patterns of both sorts are ready to act. Let a night's sleep intervene, and certain associative connections weaken, leaving others relatively stronger. An entirely different set of relations is established among the neural patterns. When the individual wakes and his neurograms become active, the right solution corresponding to these neural readjustments, 'pops into his mind.'

"A much simpler case may illustrate the point better. One is writing on the typewriter and makes a simple mistake, thereby forming a wrong associative connection between sight of a letter and the appropriate muscular response. He tries again and repeats the mistake—the nerve impulse takes the course of least resistance which is the recently used association path. How shall the error be corrected? A night's sleep is not in this simple case necessary, but a few moments of rest will serve to give the older, more frequently used, right connections the ascendancy over the newer wrong one, and the word is correctly written. The same type of interpretation covers that multitude of slips of the tongue and pen, and failures of habit mechanisms which to the psychoanalyst come under the head of the psychopathology of everyday life. Such cases of interference among association paths are known in laboratory terminology as reproductive interference. It may seem that the chances of hitting the right solution of a difficult problem in this day are slight. Genuine cases of this sort are about as rare as you would expect them to be under these circumstances. It is their rarity that makes them so conspicuous when they do occur.

"If we add to the concepts just described, the influence of motives, determining tendencies, and deeply rooted springs of action, which may be thought of either in their conscious or physiological aspects, you can account for the phenomena which in the subconscious are explained by the censor and the symbolism." [1]

Many psychologists are convinced that all the facts for which the subconscious has been devised as an explanatory principle can be explained without appealing to any concepts save those that are now well established in the science. Emphasis on the subconscious may have done for psychology what emphasis on telepathy has done, viz., proven the need of searching deeper into the complicated but normal operations of the psychophysical organism.

The "Growth" of the Subconscious.—Animals, infants, and young children do not have a subconscious. At least it is not often that we think of the subconscious as pertaining to animals or to young children. There are no facts in the mental life or in the behavior of animals and children that demand a theory like the theory of the subconscious. All adults, on the other hand, have a subconscious.

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[1] Poffenberger, A. T., "The Sub-conscious—What Is It?" *Sci. Mo.*, 1922, Vol. 14, pp. 388ff.

This is an interesting and important fact. It suggests more than anything else that the subconscious "grows," or that we *acquire* a subconscious. We acquire a great many tendencies to action and we lay down a great many incipient neural patterns which await their turn to become effective. They are the subconscious. And we acquire also a great many unpleasant experiences which we strive to forget. They, too, are the subconscious. It is upon these repressed unpleasant experiences that Freud has builded his doctrine.

Conclusion.—The theory of the subconscious is obviously a theory which has been devised to support that kind of psychologizing which is known as dynamism. It presupposes, therefore, a whole point of view in psychology, the point of view that there is a Mind, that Mind is essentially active or dynamic in its nature and that the only way to account for fixed ideas, compulsion neuroses, alterations of personality, complexes, and the like, is to suppose that the energy which these events display is of a mental sort. The theory of the subconscious has found strong support in the fact that in many types of "mental disease" no demonstrable lesions or degeneration of nerve tissue has been discovered. As has been pointed out, however, this is not convincing evidence for the significant processes of nerve function are probably submicroscopic. This suggests that one may theorize just as profitably by using concepts from modern physics and chemistry as to theorize by using concepts that derive from the "soul psychology."

PART FIVE

PSYCHOTECHNOLOGY

CHAPTER XVIII

THE GENERAL PROBLEMS OF PSYCHO-TECHNOLOGY

Introduction.—Not long ago an announcement was made before one of the American scientific societies that the diameter of the star Betelgeuze had been measured with what was believed to be a high degree of accuracy. The announcement was commented upon, of course, in a large number of weekly and monthly journals, for it seemed incredible that the diameter of a star so far away as Betelgeuze (200 light years) could be determined even approximately. The comments varied, as might be expected, from one academic or social group to another; but none was more characteristic than that which came from the average man upon the street. After a momentary expression of amazement or of admiration his first questions were: "What difference does it make?" "What good will it do"?

Pure and Applied Science.—The question "What is a thing good for?" is an old one in science. It puts before a man of science the serious problem as to how far he should go in conducting experiments that have an immediate and significant bearing upon happier or more efficient living.

As a rule, men of science have not been interested in the value of an object or in its usefulness; they have searched for *pure* knowledge, for the discovery of *pure* fact. Pure science is, by nature and by calling, impersonal, disinterested, and objective. It asks no preliminary questions about utility or commercial value. Many of its best men and most of its money are expended upon problems that are as distantly removed from practical affairs as one can imagine; hence the popular misunderstanding about research. Men explore the polar regions where life is hard; they pry into the depths of the sea; they freeze their bodies in airplanes which the rarified air will scarcely support; or they expose themselves to poisons and to insects *for the sake of learning a few new facts.* And there is not space enough to mention the thousands of like-minded but more obscure individuals at work in their laboratories upon extremely high vacua, the number of facets in the eye of Drosophila, the range of prime numbers, the distribution of certain strata, the number of electrons in the atom of an element, the combining power of nitrogen, a classified list of the organic compounds, the mental processes in a perception, the variations in the number of white rats in a litter, the specific gravity of the rare earths, or the gases in Arcturus.

The value of a science is not measured by the immediate uses to which its facts can be put but by the reliability of the methods which were employed to secure the facts. A description of the most newly discovered fossil from the glacial period is of no immediate value to an economist; but the existence of a place and of a way of observing and adequately describing even a fossil may, in the long run, be worth as much as a way to control the conditions affecting the price of a loaf of bread. To *know,* even in terms of inches, the diameter of Betelgeuze is worth while, for it means that there is being preserved in an experimental laboratory a spirit of research which is not directed by utilitarian aims or biased by the hopes or fears of a human being.

The apparent indifference of pure science toward practical problems is a penalty we must pay for the sake of an end to be gained; but, as a matter of fact, few discoveries in pure science ever remain wholly foreign to industry and the arts. The history of science has shown over and over again that discoveries seemingly remote from any sort of practical value became, sooner or later, of tremendous commercial and human worth. What we mean to say is that, if scientific detachment is preserved, practical applications will take care of themselves, but if practical values are served first both science and values are lost.

It has, accordingly, been hard to keep a proper balance between pure science and applied science. The experimental laboratory must be held free to follow any lead that may open; but on the other hand, industry, medicine, and railroading, in fact, all the arts and industries, must have special knowledge. The construction of the Hudson River Vehicular Tunnel could not proceed until the experimental laboratory had stated the conditions under which poisonous gases can be dissipated rapidly enough to insure, within a long tunnel, adequate ventilation. In spite of these reciprocities, however, there has been a tendency to keep the two interests, the scientific and the technological, apart; for both seem under such conditions to be better served.

Definition of Psychotechnology.—The task of preserving a line of separation between the pure and the applied interests in psychology has been particularly difficult, for human beings are always working, always accomplishing something. As we have said in an earlier chapter, mind is almost, if not quite, synonymous with a certain kind of getting on in the world, and the tendency has been strong, therefore, to *measure degrees* of successful getting on instead of *describing* behavior or intelligence. Memories, knowledge, thoughts, ideas, emotions, and a large assortment of complicated bodily movements are the human materials which we use in business, industry, law, and medicine. Some natural events and objects may exist neither for better or for worse; they just *are;* but it is difficult to think of human beings who simply *are;* we almost always think of them as for better or for worse, and this means either ethics or psychotechnology.

Psychotechnology, then, is that branch of psychologizing which has to do with the interpretation and reorganization of psychological facts and laws to meets the needs and solve the problems of the various arts and industries.

The Development of Psychotechnology.—The present interest in the extension of psychology to different fields of human activity began with school administrators and teachers who, because they had to deal with developing intelligence, felt that they ought to know the facts about intelligence that come from psychological laboratories. They found that success in their tasks depended as much upon their knowledge of psychology as upon their acquaintance with the social heritage.

Following the conversion of the facts of psychology to solve pedagogical problems there came a widespread conviction that psychology would be no less serviceable in medicine, in law, and in business. The application of the methods and of the facts of psychology to business began in the field of advertising. Early comers struck directly at the problem of finding what psychological factors were concerned "in the appeal of an advertisement" and in the various devices for using and controlling these factors more judiciously and effectively. From advertising interest passed to salesmanship and from salesmanship to vocational selection and guidance, or to the problem of making a detailed inventory of the mental talents of an individual and correlating these with the psychological demands of any given vocation.

The rapid growth of Psychotechnology in this and in other practical affairs is proven by an *Institut für angewandte Psychologie* in Berlin, the *Zeitschrift für angewandte Psychologie* which began in 1907, the establishment of the first professorship of applied psychology in 1917, the first *American Journal of Applied Psychology* in the same year, the Psychological Corporation in 1921, an increasing number of university courses and lectures, and a rapidly growing number of textbooks and monographs on the subject.

The Sale of Psychological "Gold Bricks."—Unfortunately for the science and for its relations to industry, medicine, and other practical affairs, the facts about mental life and the methods of getting them were, at first, inadequate to the psychotechnical problems which had been formulated. Shabby doctrines of the nature of mental life were applied to advertising, to the selection of men in industry, to the reliability of testimony, and to the treatment of the sick. Methods were superficial. As a result, the science had to stand, for a time, derision and distrust. The promise had been too great and the results failed to satisfy the hasty and unseasoned programs laid down. Moreover, individuals outside of the profession hastened to take advantage of the new science by marketing all kinds of "psychological gold bricks."

Systems for improving memory ability, exercises for increasing will power, devices for expanding the personality, methods of healing the sick, to say nothing of occult doctrines and spiritistic practices made psychology too popular. The consequences might have been serious; but fortunately the Great War forced the discipline to take its technological problems seriously, and since the war this department of research has been put upon a sounder foundation than ever before.

The Twofold Problem of Technology.—All of the problems of psychotechnology, like technological problems in general, present two sides, viz., (*a*) a list of specifications that must be met in order to make the projected undertaking possible, and (*b*) a list of the properties of all available materials with a view to meeting by adequate materials the specifications laid down. Let us illustrate these points. Let us say that modern commerce or war demands Zeppelins. We lay down our specifications as to what these Zeppelins must be able to accomplish in order to insure us a profitable and safe business. We must have lifting power, structural strength of a given amount, speed in motion, and range of action. With these specifications in mind, we go to available materials. We find that a million cubic liters of hydrogen can lift about 1200 kilograms or that a million cubic liters of helium can lift about 1000 kilograms. The latter has the advantage that it is not inflammable. Thus we pay our homage to pure science, for it has already given the technician his starting point. If we did not know these facts we should have to find them and thus pure science would gain impetus from technology. Furthermore, the specifications call for the use of structural materials that will be so light that the airship can carry a large useful load. Our specifications also include formulæ which express the limits of weight which can be allotted to the framework and the limits of strength which will guarantee the necessary margin of safety, say in a ship of ten million cubic liters capacity. The same calculations extend to types and to horsepower of motors, and to all other parts of the entire vessel. And with these specifications in hand we turn to available materials in order to search out those that meet our needs. If pure science has not already got this information it bows once more to an impetus from technology and goes in search of adequate material.

The situation is the same in psychotechnology except that psychology cannot create a human being to meet the specifications save in so far as it is possible to develop skill. The technologist in psychology first analyzes the task, makes out the specifications, that is, renders a statement of the intellectual talents that will be necessary if the task is to be performed economically and profitably. He then goes to the psychological laboratory in search of a person who has the required talents. This means that human beings have already been studied and their talents listed. The problem, then, is to bring a task and an appropriate set of talents together.

The Discovery of Talents.—It is obvious that the facts of psychology as they have been suggested in Part One do not exactly meet the requirements of the psychotechnologist. It will do the advertiser no good to address his advertisements to the general principles of psychology which have come out of a study of a large number of individuals. The advertiser is not dealing with a statistical average or a cross section but with one person, a person that is different in all his talents from every other person. The automobile salesman who says at a proper moment, "Sign here!" is not addressing a laboratory picture of a typical individual, but an individual with a particular type of emotional set, a particular kind of memory ability, a particular attitude toward his fellow human beings, and so on. The employer who has chosen a man to operate a given machine has not selected a typical but an individual person, endowed with a particular degree of excellence in the several phases of intelligence.

Psychotechnology needs, then, a way of analyzing human talent, a reliable way of determining differences of character, a sure way of discovering special aptitudes. Proposals for such a psychology have come from two sources, from character analysis, on the one hand, and from an experimental study of individual differences on the other. There are several forms of character analysis, of which palmistry or the interpretation of lines upon the hand, phrenology or the interpretation of the form and the unevennesses of the skull, physiognomy or the interpretation of the general facial and bodily lineaments, and graphology or the interpretation of handwriting, are the most common.

Character Analysis

Palmistry.—Palmistry is the oldest and, we may suppose, the parent of a very large number of systems designed not only to tell in advance of his actual behavior the character of an individual, but to predict his future as well. The system is built upon the presumption that the various irregularities and folds of the skin of the hand are associated with or imply definite kinds of intellectual talent. The origins of such beliefs are obscure but it is certain that they run back into primitive times, perhaps beyond the era of written records. The art is said to have existed 3000 B. C. in China, and references to it are fairly common in Greek literature and in early patristic writings.

It is not strange that the hand should have been chosen as the place where information about "mental abilities" might be sought, for it is one of the most mobile organs of the body. It may have played a large part in the whole history of life since, in the human family, it enabled the individual to manipulate, to operate, or to handle objects with a skill superior to all other animals. Moreover, manipulation of objects with the hands has always stood closely related to intellectual talent.

Many different parts of the hand have been used to discover character and to predict the future. Some schools of palmistry emphasize the general shape and outline of the hand, as many as eighty varieties having been counted. Such characteristics as hardness and softness, and dryness and wetness, have also been used. The most important features, however, are the lines and the elevations that occur on the palm. Of the lines, there are six that are said to enter largely into the art of palmistry. The first is the line that divides the hand from the forearm at the wrist. The second line of importance isolates the ball of the thumb. It is called the line of life. Two transverse lines which appear clearly when the hand is partially clenched are the head line and the heart line, respectively. The vertical line running from the middle of the wrist to a point just below the middle finger is named the line of fortune. Another line beginning at about the same place as the fortune line but running obliquely toward the ulnar side of the hand is called the line of the liver. Character (and the future) is said to be determined by the length of the lines, by their distinctness, and by their direction.

The lines isolate certain swellings, the most prominent of which are (*a*) the ball of the thumb, called the mountain of Venus; (*b*) the base of the index finger, called the mountain of Jupiter; (*c*) the base of the middle finger, called the mountain of Saturn; (*d*) the base of the ring, or fourth finger, called the mountain of the Sun; and (*e*) the base of the little finger, called the mountain of Mercury. Near the mountain of Mercury and between the heart and head lines is the mountain of Mars and above the heart line is the mountain of the Moon.

The size of Venus is supposed to be indicative of charity, love, and moral looseness; Jupiter is correlated with religiousness, ambition, love of honor, pride, and superstition; Saturn, when large, implies wisdom, good fortune, prudence, but, when small, it suggests improvidence, ignorance, and failure; the

Sun, when large, indicates success, celebrity, intelligence, and audacity, and when small, meanness, and love of obscurity; Mercury is correlated with love of knowledge, industry, and aptitude for commerce. If Mercury is large on one hand and small on the other love of gain and dishonesty or slackness and laziness are signified. Mars is related to degrees of courage, resolution, rashness, or timidity; while the Moon indicates sensitiveness, morality, good conduct, or immorality, overbearing temper, and self-will. The swellings on the palmar surfaces of the fingers are also indicative of certain qualities. The first and second swellings on the thumb, for example, are supposed to reveal logical faculty and will power. The first, second, and third swellings of the index finger indicate materialism, law and order, and idealism. On the middle finger are found humanity, system, intelligence. On the ring finger are truth, economy, and energy, and on the little finger are goodness, prudence, and reflectiveness. More than a hundred other marks, crosses, triangles, and folds have been described and each has been given its proper interpretation.

Phrenology.—Phrenology is the alleged art of discovering individual differences in talent and in character from the shape of the head. It is based upon five principles, viz., (*a*) all mental processes are accompanied by processes in the brain; (*b*) all the intellectual talents of a person can be separated into a definite number of independent "faculties"; (*c*) these "faculties" are innate to an individual and each has its seat in a definite part of the brain; (*d*) the size of each of these regions is an index of the degree to which any given capacity is to be found in an individual; and (*e*) the correspondence between the "bumps" on one's head and the size of the brain area just below is close enough to permit examining the outer surface and interpreting therefrom the character and talent of the individual.

Phrenology in its earlier form was known as cranioscopy, or craniology, these names having been used by the founders of the modern form of phrenology, Gall, Spurzheim, and Combe. The antecedents of phrenology, like the other means of character analysis included in our discussion, are exceedingly old. One of its fundamental principles, viz., that mental life is dependent upon the brain, has been stated, with many variations, since the time of the early Greeks. Many of the philosophers and naturalists sought to locate special functions in various parts of the brain; Albertus Magnus, for example, assigning judgment to the anterior region, imagination to the middle, and memory to the posterior regions of the brain. He was followed by an increasing number of individuals who allocated various functions to different parts of the brain; but the expansion of the old system into the modern system was done by Gall.

Gall did more lecturing than writing; but even as a youth his public discussions of the relations between outward appearance and the mental qualities of his schoolfellows excited much interest. In 1800 he found a pupil and a staunch admirer in Spurzheim and together they built up a system of psychology which was easily made over into a system of character reading. Gall expended most of his energies in France, while Spurzheim carried the doctrines to England and from there they were carried to America by Combe. By 1832 there were 29 phrenological societies in Great Britain and numerous journals were published in behalf of the new science.

Gall's system was built up from his own observations on the skulls of his friends and on the skulls of criminals and of the insane. Originally he had marked out some 26 areas on the head which represented as many mental faculties; but Spurzheim and Combe, believing that every part of the skull was significant, extended Gall's ideas by dividing the whole cranium into oblong and coterminous patches. The general scheme of Gall and Spurzheim has been modified in certain respects; but, on the whole, their classification of mental functions still persists. Among the qualities that were listed are amativeness, love of children (philoprogenetiveness), concentration, adhesiveness, combativeness, destructiveness, alimentiveness, secretiveness, acquisitiveness, constructiveness, self-esteem, love of approbation, cautiousness, benevolence, veneration, conscientiousness, firmness, hope, wonder, ideality, wit, imitation, individuality, form, size, weight, color, locality, number, order, eventuality, time, language, comparison, and causality. The first eight or ten qualities were referred to regions in the occipital lobes, the next ten to the top of the head, and the remainder to areas about the forehead and near the eyes.

Gall's observations were made in the following manner. He was introduced one day to an ecclesiastic of hesitating disposition who had large parietal eminences. He located, therefore, cautiousness in that region. Gall saw one day a protuberance on the head of a lunatic who fancied herself the Queen of France. He placed the love of approbation in the region. The combative area was located by finding a protuberance common to several quarrelsome and low-bred fellows whom Gall had stimulated with alcohol. The area was verified by comparing the region with a similar region on the head of a quarrelsome young lady. The first area located by Gall was the language area, which was related to the eyeballs since one of his school friends was clever at languages and possessed prominent eyeballs. The head of Fichte and the bust of Kant served to locate the causality area an inch or so above either eye. While visiting churches Gall found that those who prayed with the greatest fervor had prominences at the very top of the skull.

Physiognomy.—Physiognomy is a name for a supposed science which discovers mental differences in the general lineaments of the body. It again is as old as history and it has stood, for the most part, pretty close to divination and astrology. Classical examples of the use of physiognomy come from Greece, where Socrates is alleged to have recognized at sight the superior mental qualities of Plato, his student and follower. Aristotle has given us the earliest systematic account of this pseudo-science, describing in some detail the bodily characteristics representing strength or weakness, genius or stupidity, timidity, imprudence, and anger. The bodily features most frequently used were skin color, hair, limbs, gait, voice, and the nose. Of noses he described nearly a dozen. Noses with thick bulbous ends belong, he said, to insensitive, swinish persons. Sharp-tipped noses belong to the irascible and easily provoked; slender-hooked noses to the noble but grasping; round large obtuse noses to the magnanimous, and so on. The movement grew rapidly up to the sixteenth and seventeenth centuries; but declined after the facts of physiology came to be generally known.

Graphology.—Chirognomy or graphology is the alleged art of reading character from the handwriting. Systematic progress in the study of handwriting seems to date from 1662 when Baldo published in Italy a treatise on the method of determining character by this means. Many notable people have subscribed to the general features of the study, among whom are Leibnitz, Goethe, and Sir Walter Scott. Goethe seems to have been especially interested in the matter, for he is known to have carried on a large correspondence while discussing it with his friends.

The materials used in this sort of study are (*a*) the degree of the slope or slant of the letters; (*b*) the character of the connections between the letters, whether sharp and angular, or round and curved; (*c*) the length of the connections; and (*d*) the character of the disconnections between the letters and words. When the writing slopes greatly toward the line of writing, that is, when the line of the letters makes an angle of approximately 20 degrees with the line of writing the individual is apt to become excited quickly. Persons whose writing slopes so greatly are said to possess sensitive natures and have but little moderation in their actions and speech. As the angle increases to 50 or 60 degrees the individual becomes normal. Writing which slopes backward is supposed to indicate coldness. If the last stroke of the letters *g* and *y* runs downward in the middle of a word "it is a sure sign of stubbornness, and of a domineering spirit." If the same sign appears at the end of a word it signifies a spirit of independence and love of truth or justice. If the " t " dashes are made with long strokes running upward, they signify " enterprise, zeal, ambition, and enthusiasm." The person who crosses his "t's" by running the last stroke of the word over the "t," "will hold to his views, no matter what may happen." If this sign appears with certain other signs it signifies that the writers will "brush aside unmercifully all who may be in their way, so that they may win and carry out their purpose and design." Other signs are supposed to represent independence, pride, love of luxury, liberality, spendthriftness, and the like.

Criticisms of Character Analysis.—It is unfortunate that except in the matter of handwriting little or no direct experimental evidence can be brought to bear upon the assertions of the character analysts. There are, however, a number of inferences that can be drawn from various sciences and these inferences point so conclusively against the kind of thing we have been discussing that psychologists have hardly deemed it worth while to bring many of the problems into the laboratory.

The Physiology of the Hand.—The palmist, for example, forgets that the hand and the skin upon it serve an entirely different purpose from the one he alleges. The folds and the creases are arranged not by "mind" but by mechanical needs, so that the thick skin shall be capable of bending as in grasping. At the same time the skin must be drawn over the skeleton tightly enough to prevent slipping or folding over upon itself. For this purpose the skin is literally tied by connecting fibers of white tendinous tissue to deeper layers of the hand. The folds, therefore, do not vary with mental or physical qualities but with the tension and lengths of these fibrils and with the size and nutritional condition of the bones and of the muscles. That such mechanical arrangements should be indicative, in any manner whatsoever, of the future or even of one's own abilities is pure fancy. The presumption springs out of an unhealthy mind's crude attempts to get out of the world as much mystery and occultism as it will stand.

Gall and the Mind-Body Problem.—Phrenology stands in a little different relation to the development of psychology than do the other pseudo-sciences we have discussed for Gall was genuinely interested in a doctrine of cerebral physiology. He wrote at a time when the principle of psychophysical conjunction was gaining in importance both for psychology and for physiology. In other words, Gall brought the best of his knowledge to bear upon a venerable problem, the problem of the mind-body relations. His doctrine of cerebral localization did a great deal to hasten the day when better methods should reveal, not the specific dependence of mental life upon definite areas of the brain, but the general dependence of mental life upon neural functions.

Gall occupies a definite place in the history of psychology. His system, however, was soon lost to science, for in the hands of students of alchemy, palmistry, and astrology, it became an occult means of reading character. This sort of phrenology goes wrong in several respects. In the first place, modern psychology knows nothing of "mental faculties." This phrase Gall secured, apparently, from a psychology prevalent in Germany and owing its origin to the philosopher Christian Wolff. In Gall's own day these faculties were thought of as mental forces or powers of reasoning, of judgment, of imagination, and the like. Gall's doctrine implied that one particular part of the brain was reserved for the sole occupancy of a mental "something" which, on occasion, organized mental life or behavior in predetermined patterns. In the second place, physiologists now know that the nervous system does not operate in the piecemeal or compartment fashion demanded by Gall's system. The nervous system is to be likened, on the contrary, to a piano upon which an elaborate composition is being played. No single part of the piano, no single string is more essential than other parts or strings. That is to say, the whole instrument is contributing to the production of the music. It is true that now some strings and then others contribute, for a moment, more than their share; but even the emphasis is in *respect to* the performance of the whole piano. In other words, the nervous system is a tremendously complicated instrument, all parts of which are operating at once in a highly organized and integrated manner to condition mental life. In the third place, many modern psychologists are by no means certain that mental life possesses any sort of energy in and of itself. That is to say, imagination is not a product of the operation of some mental power or force, but a result of the fact that the organism has learned to expect in the future that which has already manifested itself in the past. Combativeness is not the result of the operation of a mental faculty; it again is a complicated behavior pattern. Finally, the nervous system does not grow as phrenology demands. Growth in "mental ability" implies increasing neural organization and not increasing nerve substance. Whatever adult growth there may be consists of an increase in the depth and in the number of convolutions in the brain and not of an increase in the nerve tissue at any given place. Moreover, "mental ability" seems to be less a function of brain weight or brain size than of brain area. The brain area is increased, as we have said, by an increase in the number and depth of the convolutions rather than by a sheer increase in size.

Experiments on Handwriting.—The only one of the "characterologies" to be brought into the laboratory is chirognomy. The first serious attempt to bring graphology under laboratory conditions was made by the French psychologist Binet. His experiments were conducted in the following manner. In a first trial he presented to his subjects, who were famous graphologists, 180 addressed envelopes which had been written in about equal numbers by men and women. The subjects were to tell the sex in each case. The highest score was 79 per cent right guesses. Other scores stood well above the percentage one would expect through chance. In a second trial, Binet secured samples of writing from 37 subjects of high standing, and with each he paired a sample from a person of similar education and social level but of mediocre intelligence. The judges made surprisingly few errors in determining which writing indicated the higher intelligence. In a final test Binet paired the writing of nine notorious murderers with nine honest citizens of rather humble rank. The correct guesses of morality were not so good but still above chance.

A great many experiments have been completed since these pioneer studies by Binet, but the general result is about the same. The explanation of this reasonable accuracy in judging character, intelligence, age, and sex from the handwriting lies in the fact that handwriting, like speaking, is a mode of behavior of a creature. These modes of behavior may suffer some distortion in the school through the attempt to standardize writing and speaking, but almost invariably some expression of the general native motor habits of an individual must shine through the formal habits gained in the schoolroom.

Summary.—Except for handwriting, there is little in these various popular methods of character analysis to commend them to a person of even average critical ability. All of them rest, as we have seen, upon the crudest sort of physiology and upon circumstantial evidence of the flimsiest texture. The observations upon which all of them are based are admirably illustrated in the following manner. The general mental and moral character of Theodore Roosevelt was known, of course, to almost everyone. By cartoon and by public reference, many persons became familiar also with his most prominent physical characteristic, viz., his gleaming set of teeth. It is not surprising, therefore, that so dominant a physical characteristic should have been related to his dominant mental charateristics. As a matter of fact, the correlation between prominent teeth and dynamic personality has been added, in at least one case, to the list of physiognomic characters. In other words, the pseudo-sciences of characterology seem to be based upon the common tendency to transform coincidences into causal relations and thence into scientific fact. This tendency, augmented by some of the motives described in the paragraphs on occultism, results, finally, in a doctrine of character reading based professedly on the method of the sciences, viz., on controlled observation, but based as a matter of fact upon a misuse of those conditions which make observation significant.

Judging Human Character from Behavior

In spite of sarcasm and criticism, men and women do still profess to judge character and intelligence. Not only do they profess to derive talent from the face and from bodily mannerisms but they issue statistics showing that their percentage of successes is much higher than can be accounted for in terms of chance. Obviously, character and intelligence can, under certain conditions, be estimated. What are these conditions?

Personal Habits.—In one of the chapters of the section on Social Psychology we discussed the products of mental life, the things that have been done by human beings because they were intelligent creatures. It will be recalled that languages, religions, customs, laws, and institutions could be listed as monuments to mental life, inventions that reflected the intelligences which brought them to pass. In other words, intellectual products are, to a certain extent, indices or evidences of individual and racial talent.

We may now make use of this principle again. There is no reason why a trained person might not take advantage of other witnesses to character and to training, witnesses which are rather small and insignificant compared with religions and institutions, but which are, nevertheless, fruitful in modern commerce and industry. Training and innate intelligence or character bring about changes in a man's clothing, in the condition of his hair, in the condition of his hands and finger-nails, in the character of his spoken words, in his address to his superiors, equals, and inferiors. These things are not mental life, they are not intelligence, but they are, with proper reservation and foresight, indicative of character and intelligence. They are witnesses to something.

Gait and Bearing.—The amount of mineral matter (calcium and other mineral salts) in the human system, and consequently the size of the chin bone, is a matter of food and not a matter of will power. There is no more reason why the size of the nasal passages should indicate character than the size of the feet. Nevertheless the facial features and the gait of a man say something about his habits. Recall, if you can, the faces of last year's all-American football team. These faces are hard, determined, alert. Take a picture of a half dozen air-mail pilots. They appear to be the cream of strong-willed manhood. Football, all-night flying, re-create a man's face. His muscles fall into the habit of preserving a certain *determined* expression. A linesman dare not charge his opponent with his mouth open and his face relaxed. His face falls into the habit of being determined. We who see him judge him to be a determined man because we know from experience that that is the way a man should look when he is intent upon getting a task done.

But wait a few months! Take pictures of the same football men after the season is well past and those who are so disposed have settled down to softer and less heroic living. Now the faces are softer, the lines are less determined, and we judge differently the character of the same men.

In this illustration we find a suggestion of another aid to the character analyst. Men not only learn skills and fall into habits which involve hands, fingers, and feet, but their faces form habits. If a man's step is alert, his handshake firm, and his face becomingly hard, we may know that his manner of living is other than that of the soft-faced "tea-hound." But to the dismay of the character analyst the "tea-hound" may have been the first to have silenced an enemy machine-gun nest!

Emotional Expression.—A goodly number of recent experiments have attempted to analyze a man's ability to judge emotional expression from the face. Facial expression of emotion is approximately the same for all races of men and a number of the more common expressions appear also in the lower animals. Children acquire them without being tutored. It looks as though such expressions rested upon hereditary factors. As a matter of fact, Darwin was so impressed with their universality and apparent antiquity that he sought to find an explanation for them in terms of natural selection. In view of these facts we might expect that judgments of the emotions expressed in faces should be reasonably accurate. Experiments have been performed using either faces from a standard work on emotional expression by Rudolph[1] or by using a mechanical face (after Titchener and Boring) in which noses, eyes, and mouths bearing different expressions could be inserted. In these experiments accuracy of judgment was found to be surprisingly low, even when the expressions were among the commonest. Laughter was identified most frequently (64 per cent), but anger only 30 per cent, and disgust and fear 36 per cent each (Langfeld).

Perceptual Inference.—In the above experiments it was often found that the judgments of emotional expression were given after the subject had attempted to imagine a situation which would produce such an expression. This is true also of the judgments we make of the transient mental processes of another person. It may be true of more fundamental phases of character analysis. That is, before we judge of a facial expression we imagine a situation or a mode of reflection which has often produced in us a similar facial expression. The judgment may be more direct than this, however, for we often *see* that a table is *hard*, or *hear* that an object is *heavy*. That is, we may make an immediate perceptual inference about the mental life expressed in a face just as we appear to make an inference about hardness from what we see.

Experimental Methods of Discovering Character and Talent

For convenience in discussion, experimental tests and measures of human character and talent may be thrown into two groups. There are, first, those tests and measures which aim in a formal way or in a laboratory way at a measure of some phase of intelligence without regard to how, when, or under what conditions the talent is to be used. We may, for example, measure the reaction time of an individual and know whether he is slow or quick in a simple response to a simple stimulus. Using proper caution we may then go ahead to infer that he will be just as slow or quick whether he is charging in football, batting in baseball, getting around and through traffic with his automobile, or striking at the moth miller which flits over the table in front of him.

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[1] Rudolph, H., *Der Ausdruck des Menschen.* Rudolph used 680 drawings and photographs of a German actor who was exceedingly clever in manipulating the muscles of his face.

There are, secondly, those tests and measures which depend upon the erection in the laboratory or in a factory of a situation as much like the actual situation as possible, the chief differences being that the laboratory affords means of controlling the conditions and making appropriate measurements. It is not always necessary to bring the test situation into a laboratory, for an experienced psychologist may go directly to the workshop, the salesroom, the law court, or the schoolroom and make such observations as seem pertinent to the problem in hand.

Psychological Assays.—It is not always necessary to test every phase of intelligence in order to make a statement about the qualifications of a man for any given job. The assayist does not undertake to test all of the ore that comes out of a mine. He takes samples and assumes that his samples will give a reliable indication of what, on the whole, one may expect from the mine. The highway engineer does not cut test blocks from every yard of a newly laid pavement. He assumes that blocks taken at much larger distances from one another will give a faithful picture of the slab that has been laid. So in tests and measures of intelligence. The human engineer does not have to have a measure of every piece of behavior throughout the livelong day. He takes samples here and there and assumes that these samples will tell accurately enough how high or how low in talent the whole individual stands.

Or, let us take another anology. The procedure of the assayist in psychology is somewhat analogous to that of the physicist who is attempting to work out the correlations between temperature and pressure in a closed vessel containing gas. There is, of course, no way to get a direct measure of those events which we may call molecular activity. The physicist reads an arbitrary scale which he calls the temperature scale and he reads another arbitrary scale which he calls the pressure gauge. These two readings give him information about something that he cannot otherwise know about, namely, the molecular condition of the gas which he is studying. These measurements are not of something which a gas *has.* They are of something which a gas *is.* The molecules are in motion. Likewise in psychology! We search for two scales, the one which is representative of the performance of human beings, say in typewriting or in automobile driving, and the other of the same or similarly endowed individuals in a simple test task which we have formulated. We seek to find correlations between the reading which we make upon these two scales. If we call our results "measurements of intelligence" we do it only as a shorthand way of expressing our facts. Intelligence is not something a person *has.* It is something that he *is.* It is something we may say of a person after we have seen him in action either outside of the laboratory or within the laboratory. The aim of the laboratory situation is to find a scale in terms of which one can make predictions about the performance of this individual outside of the laboratory.

The Establishment of Norms.—Before any test has a substantial diagnostic value the creator of the test must seek to establish a *norm*, *i.e.*, a standard or degree of excellence. We are already familiar with the form of the normal distribution curve and we know that all data about human beings, whether physiological or psychological, tend toward such a distribution. The high point of the distribution curve is often taken as a norm. Let us assume, for example, that ten thousand five-year-old children have been given the tapping test. Some will be slow, and some will be fast, while the most will be average. Now we may wish to test one additional child. The record which this child makes in the tapping test is significant only with respect to the average rate of tapping of other children of his own age. It is obvious that the average or the norm must represent the abilities of a great many children. The greater the number, other things being equal, the better the average will serve as a norm. It is also obvious that the norm is not a standard external to and unrelated to human performance. The value of the average is a pragmatic value which arises within the total group that is to be studied.[1]

The reader is asked to keep these things in mind as we go on to describe or to list, in the briefest manner possible, some of the common tests and measures of talent. We remind the reader also that we are illustrating problems and methods and not giving a detailed exposition of the thousands of tests and measures that are now available.

Tests of Strength and Endurance.—Martin has worked out a method of testing the strength of twenty-one pairs of muscles, using so simple a piece of apparatus as a spring balance. It has been found, however, that a measure of five or six of the major muscle groups gives a good index of bodily strength. A special piece of apparatus called the hand dynamometer has been devised to measure the strength of grip and this measure has often been used as an index of bodily strength.

Endurance and the relation of fatigue to continued effort may be measured by means of an instrument called the ergograph. In this test a weight is attached over a pulley to a single finger, and the subject is asked to raise and lower the weight by means of successive flexions of the finger. The excursions of the weight as it rises and falls may be marked upon a smoked drum or other writing point.

Tests of Motor Control and Dexterity.—Holding a stylus in a small hole steadily enough to prevent the point of the stylus from making an electric contact through the wall of the hole, running a stylus quickly but accurately through an irregular pathway without making contact with the sides of the pathway, throwing a ball or a dart at a target, tracing complicated patterns quickly and accurately, tapping with a stylus against a brass plate and counting the taps by means of an electric counter, measuring reaction times under simple and under complicated instructions, these and a hundred other means may be used to establish the motor control and dexterity of an individual.

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[1] Read Garrett, H. E., *Statistics in Psychology and Education*, 1926.

Tests of Perceptual Acuity.—We need only to remind ourselves here of what has already been said on p. 136 concerning psychophysical methods and measurements. The Weber-Fechner Law was an attempt to derive a general principle from tests of perceptual acuity. In addition to these psychophysical measures there are dozens of other special measures such as color blindness tests for railway employees, tests of auditory acuity for the discovery of musical talent (p. 587), tests of tactual acuity for cartridge makers, and the like.

Other Special Intellectual Talents.—The reader can now see what we mean when we say that there is a test for almost every special phase of mental life and of behavior. There are tests of memory ability, of imagination, of reasoning, of mechanical ingenuity and of every other particular talent which a human being may possess. The plan of them all is the same. Each test offers itself as a simplified but diagnostic substitute for the total piece of behavior that must be exercised in industry or commerce, in the schoolroom or on the athletic field.

Men disagree, even violently, about the proposition as to whether there are any measurements that are significant beyond the situation that first suggested the test. We are, for example, testing memory ability by the use of nonsense syllables. We obtain a distribution curve and establish our scale. Now, will readings on this scale, which is based upon learning nonsense syllables, be diagnostic of the rate at which a person could be expected to learn how to drive an automobile? Can one take a half dozen different measures based upon a half dozen different scales and say of these measures that they represent the intelligence of a person? The next few paragraphs will throw a little light upon this vexing question.

Tests of General Intelligence.—There is, as yet, no precise and generally acceptable definition of "general intelligence." Binet and Simon, the authors of a pioneering method of "measuring" intelligence (see p. 244) characterized it by the presence or absence of a fundamental faculty called "judgment." Judgment is "good sense, practical sense, initiative, the faculty of adapting one's self to circumstances." To judge well, to comprehend well, to reason well, these are the essential activities of intelligence. A person may be a moron or an imbecile if he is lacking in judgment; but with good judgment he can never be either. Indeed the rest of the psychology of intelligence seems of little importance in comparison with judgment."[1] Other writers affirm that intelligence is a capacity, distinct from specific abilities (memory, discrimination, comparison, and the like) to adjust one's self to new or unfamiliar situations. This capacity is alleged to be innate rather than acquired, to be relatively unmodified by education, to be relatively independent of acquired capacities. The term is also used merely as a collective term for the specific capacities of the organism (see p. 36).

The failure to derive an exact definition of intelligence has not stood in the way of attempts to measure each specific talent or even to measure the hypothetical general capacity itself. In the laboratory the complicated performances of perceiving, judging, comparing, discriminating, selecting, imagining, remembering, resolving, creating, reasoning, choosing, manipulating, and devising, are stripped of as much complication as possible and in this laboratory form they are administered to individuals under precise conditions and under accurate means of measurement. Measurements secured under laboratory conditions and with laboratory forms of the intellectual talents are alleged to hold for the virgin capacities and in educational or industrial situations the individual is provisionally placed according to his ability as revealed in these measurements.

The Army Alpha Test.—In Chapter VII we have given a brief résumé of the Stanford revision of the original Binet-Simon tests for the measurement of general intelligence among children. Here we shall limit ourselves to a short description of a typical intelligence test for adults, viz., the Army Alpha test.

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[1] Binet, A., and Simon, Th., *The Development of Intelligence in Children* (tr. by Kite), 1916, p. 42.

The first test aims to measure the examinee's ability to understand simple verbal directions. He finds, for example, a triangle drawn over a circle and at the signal "Go!" he is asked to put a cross in a space that is in the triangle but not in the square. There are twelve such requests to obey instructions. The second test comprises twenty arithmetical problems running from simple to complex and the subject is to work out as many as possible in the time allotted. The third test is a test of "common sense." The test states (to take a single example) that shoes are made of leather (*a*) because it is tanned, (*b*) because it is tough, pliable, and warm, or (*c*) because it can be blackened. The examinee is to mark the answer which he thinks is best, thus exercising his practical judgment. In the fourth test one finds forty pairs of words. Some of the pairs are synonyms, that is, mean the same thing, while other pairs mean the opposite. The subject is to indicate which as rapidly as he can. The fifth test is made up of sentences the words of which have been badly disarranged. The subject is to think of the sentence as it should read and then indicate as quickly as possible whether it is right or wrong.

Let us suppose that you have been given the following series of numbers: 8 9 12 13 16 17. You are asked to continue the series. You would then write as the next two in the series: 20 21. This is the sixth test. Twenty series of numbers, each number in each series bearing a certain relation to the others, makes up the test. Number seven is an analogies test. We find, for example, among other groups in this test the words good—bad :: long—tall big snake short. The examinee is asked to underline that word among the last four which is related to long as good is related to bad. There are forty such anologies to discover. The last test is a test of general information. For example, is Crisco a patent medicine, disinfectant, tooth paste, or food product? The subject is to underline the appropriate word and he does likewise with forty such questions.

The Beta test is anologous to Alpha save that it is designed for illiterates.

The theory underlying such a test is as follows. The examinee is forced to make a variety of judgments, discriminate similarities and differences, solve problems, obey instructions in a situation which, although controlled and much simplified, is much like situations actually met with in life at large. It is thought that a measure gained in an hour of such examination should be a faithful reflection of what can be expected of the examinee outside of the laboratory.

Educational Tests.—In addition to the tests of general intelligence which we have just mentioned and which are obviously of tremendous importance to teachers and school administrators there are hundreds of tests of proficiency in almost every elementary and secondary-school subject. "An idea of their number and scope may be gained from the following list, taken from a recent bibliography: English (Composition, Copying, Grammar and Punctuation, Language, Poetry, Spelling), 48 tests; Mathematics (General, Arithmetic, Algebra, Geometry), 45 tests; Reading, 40; Handwriting, 24; Science (General, Biology, Chemistry, Geography, Physics), 24; Foreign Languages (General, French, German, Latin, Spanish), 17; History (General, American, Ancient), 14; General school-survey tests, 7; Commercial, 5; Drawing, Home Economics, Vocational Subjects, and Manual Training, 4 each; Music, Physical Training, 3 each; Citizenship, Journalism, 1 each." [1]

These tests and measures answer the question: How proficient has a pupil become in any subject after so many weeks or months of instruction. The teacher used to be the sole authority on this point and that authority was expressed in terms of grades and marks. The tests above have been standardized so that any pupil may be measured against a norm in any one of the subjects mentioned instead of against the variable judgments of a teacher.

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[1] Robinson and Robinson, *Readings in General Psychology*, p. 610. Quoted from Kingsbury.

Trade Tests.—During 1918 the United States Army devised and standardized tests for eighty-three different trades. These tests were created for the sake of finding in the various army camps those men who were particularly qualified to fill any particular position well. Among the trades listed at that time were those of auto-repairer, baker and cook, office clerk, various electrical trades, machinists, printers, telegraph and wireless operators, etc. Since that time the number of distinct trades has run into the hundreds and for practically all of them there is some test.

Trade tests are of three types. In the first the applicant is given, by word of mouth, a number of questions relating to his trade, questions which can be answered in only one correct way, by a single word or phrase. The answers determine the qualifications of the applicant. In the picture test the applicant is given a picture of different phases of his work or a picture of tools and he is asked questions concerning the details of the picture. In the performance test the applicant either goes immediately to work under the eye of a competent judge, or he is given a standardized task to complete which will involve the same skills and talents as the job itself.

Tests of Personality and Character.—All of the tests which have been mentioned up to this time have had to do with overt action systems, either manual or verbal, but the organism meets its environment also by assuming attitudes, and by varying the general tonus of its reaction patterns. Those attitudes and dispositions which hold over for long periods of time and which put the impress of the individual upon the environment we call personality traits. Other attitudes and dispositions are known as temperament, will, and the like.

That there is a tendency toward a definite type of overt reaction on the part of each individual is the premise on which the so-called will temperament tests, of which the most highly organized is that of Miss June E. Downey, are based.[1] Miss Downey considers handwriting a representative mode of behavior by which to judge the will temperament characteristics, and has devised an elaborate system of tests to determine the presence or absence of what she considers the two fundamental factors involved in will temperament, viz., "the amount of nervous energy at the disposal of the individual," and "the tendency of such nervous energy to discharge immediately into the motor areas and innervate the muscles and glands, or, on the contrary, to find a way out by a roundabout path of discharge." To this end, tests are offered of speed and fluidity of reaction, speed of movement, freedom from inhibitions, flexibility, speed of decision, decisiveness of reaction, carefulness and persistence of reaction, etc. Out of the tests comes a profile which is said to represent the will temperament of any given individual.

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[1] Downey, June E., *The Will Temperament and Its Testing*, 1923.

Tests of moral judgment or of æsthetic sensibility are made by asking questions about moral situations or presenting æsthetic objects and asking subjects to render judgments on the material.

The reliability of all such measures is yet to be determined. At the present time they do not give more than very general estimates of the moral and æsthetic sensibilities of people. This is not to be wondered at since the tests are usually nothing more than a crowding into a short time of the same number of moral or æsthetic situations upon which one might have to render judgment in a month's time.

CHAPTER XIX

PSYCHOLOGY AND EDUCATION

Introduction.—Long before psychology became an experimental natural science, educational administrators and teachers were listening to the speculations of philosophers who had undertaken to be psychologists and who were, on that account, spinning out theories of the nature and constitution of mind, for it was early recognized that any adequate system of education must be established upon a psychological foundation. The aim of education, the content of the curriculum, methods of teaching, forms of supervision and administration all should depend more or less completely, it was believed, upon a thorough understanding of mental life. Intelligence stands at the very center of the whole educational process and it is for this reason that the history of education and the history of speculative psychology fall so close together. It is for the same reason that the history of psychology as a science runs along with the history of experimental education as one of the chief branches of psychotechnology.

Definition of Education.—Education is, in the first place, a process of increasing and refining the capacities of an individual to gain knowledge, a process of teaching him how to elaborate upon the knowledge he has gained, and how to act intelligently and appreciatively with respect to it. That is to say, education is the art of training the talents of a child in such a way that they can be made more serviceable to him in the business of living. The materials for this course of training come from two sources. The individual may, on the one hand, be sent directly to a small part of his environment and asked to exercise his talents in getting along with it. On the other hand, he may go to the attempts which his forbears have made at training their own abilities and learn from them their successes and their failures. The emphasis which education is now placing upon the development of the mind-body capabilities is reflected in many of the "new" methods of teaching. We hear, for example, of the Gary system, the Montessori methods, and the project method. The training of capacities is also illustrated in vocational schools where an attempt is made to complete as early as possible various types of technical training.

In the second place, education includes the task of arranging and making known to the oncoming members of society that part of the total acquisition of the race which society may, from generation to generation, consider most valuable. The world as it exists about us invites scrutiny. It is a world to be known, to be understood, to be altered or changed as our human needs may require. The race has been engaged in these tasks for centuries and there has been accumulated a great amount of information or knowledge that is bequeathed, through the schoolroom, to each new member of society. There are, in addition, a number of objects—the literatures, art, music, and the like—which are in the world because of the existence of minds, and the new individual has also to learn of these "mental products," as they may be called. In other words, the child of today must, if he is to take his part in society, begin where the race left off yesterday, both in the development of his intellectual talents and in the range of his information.

The Problems of Experimental Education

The art of educating the youth a hundred years ago was by no means so complicated as it is today. Indeed it was hardly recognized that there could be serious experimental problems in the process, for there was prevalent, at that time, a philosophical and political doctrine that all men are created free and equal, not only as regards their rights of citizenship but as regards their intellectual capabilities. In other words, all men were alleged to be endowed with equal "thinking principles" and the art of educating men consisted of nothing more nor less than cajoling or prodding this mysterious "thinking principle" through a curriculum. The obstacles hindering the process were individuals possessed of "evil spirits" or those who were "carnally" lazy and willful. The former, however, were put in chains and the latter were physically punished. The problem of education was, therefore, fairly straightforward. The "possessed" need not be educated, and the lazy must have an education thrust upon them. The remainder, being equally endowed at birth, went through a common curriculum. Low standards of work were inexcusable for they were taken as evidence of lack of industry rather than of variable abilities. This form of education made it possible for an old schoolmaster to boast that in fifty-one years of teaching "he had given '911,500 canings, 121,000 floggings, 209,000 custodies, 126,000 tips with the ruler, 10,200 boxes on the ear, and 22,700 tasks by heart.' It is also reported to his credit that 'he had made 700 boys stand on peas, 6000 to wear the fool's cap, and 17,000 hold the rod.'"[1]

The Meaning of Individual Differences to Education.—In spite of certain echoes of this doctrine of equality which now persist, presumably because of the expression it has enjoyed in our national constitution, we have come finally to the point where we know that children are not equal. In the words of Galton men now no longer have patience "with the hypothesis occasionally expressed, and often implied, especially in tales written to teach children to be good, that babies are born pretty much alike, and that the sole agencies in creating differences between boy and boy, and man and man, are steady application and moral effort."[2]

Children are not equal in weight, in height, or in any other physical character; they are not equal in visual acuity, memory ability, ability to make motor coördinations, reasoning ability, or in general intelligence. As we have seen from our discussion of superior and inferior types of mental life and from the paragraphs on Differential Psychology, human talents are not apt to be equal in any respect whatsoever. They run in their degrees of ability from the pathetic infantilism of the idiot to the creative generalizations of the genius. The intelligence of the low idiot, as we have seen, stands far below the intelligence of many of the animals. The talents of the genius, on the other hand, are so far above the talents of the lower animals that many have taken the divergence as evidence of a great gap in the scale of animal life. Even among persons who are "normal" a large number of variations exists. No normal human being is fitted to every task. Education does not have to do with "typical" or "average" levels of intelligence. It has to contend with the fact that, in a group of one hundred pupils, several individuals may possess three or four times the general intelligence of the remainder. It has to contend also with personality differences. Life has never been standardized and there is no likelihood that it ever can be.

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[1] Swift, E. J., *Mind in the Making*, 1898, p. 95.

[2] Galton, F., *Hereditary Genius*, 1892, p. 12.

The Nature of Childhood.—The new art of education has to consider other facts not available to the educators of a generation ago. We discovered in our survey of child psychology that the child is not a small edition of the adult, and neither is he an advanced sort of animal. He presents to the psychologist a difficult and unique problem, for he stands on the threshold of his mental life with a nervous system rich in possibilities but poor in actual achievement. We found, moreover, that the mind of the child does not grow by a mere process of addition, by the laying of one day's experiences upon another. The development of intelligence is not merely a quantitative change; it is a qualitative change as well, a change in kind. It is probable that at birth the child is without intelligence save for reactions to diffuse, obscure pressures, to a few qualities from the light series, a few tastes, and the like. For several days the child may hear nothing and react only to expanses of light and shadow. Out of so meager a beginning the adult must grow with his complicated deliberations, his clever anticipations, his great mass of reliable memories, and his fine ability to use and to coördinate his muscles. Upon the simple foundation of a few reflexes the perceptual acuteness of the child is erected. He jumps rapidly from accomplishment to accomplishment; now he is remembering and then reasoning; his ability to learn about the events of his world and to modify its properties to suit his own needs improves with every day. We must repeat again, then, that the development of the child is not a process of simple addition, nor the random placing of experiences, the one upon the other; it is a progressive organization and reorganization of behavior patterns from one complexity level to another. An adequate system of education must, then, meet the mind of the child at various ages and devise its problems accordingly.

The Meaning of Infancy.—In the third place, the problem of education is important on account of the long period of infancy. When the amœba, the little one-celled animal from a pool of stagnant water, reproduces its kind, the new individual is just as complete structurally and functionally as was the parent. But as we ascend the animal scale, we find individuals which must pass through varying periods of infancy before adulthood is reached. In the human species the interval between birth and maturity is comparatively long.

The early phases of human infancy constitute a period of extreme helplessness. The new individual cannot even feed itself, not to mention satisfying its other needs. It is wholly dependent upon its parents for a number of years and only after a still longer time is it able to live its life in independence. It is during this period of helplessness that a considerable part of the process of education takes place. As much of the process must be crowded into the years of partial dependence as is possible, for the nervous system is then plastic and can be easily and deeply impressed. In a certain sense, the foundation of all of the later accomplishments of the individual must be laid during this period. The methods to be used and the difficulties to be overcome are, therefore, important.

Summary of Problems of Experimental Education.—Under the conditions we have just described the reorganization of psychological facts and principles for the sake of educational practice becomes a real problem. There are problems of administration, inquiries directed toward the personality of the teacher and toward his relations to his students, questions as to the best manner of securing an index or rating of the teaching ability of the instructional staff and of the actual degree of achievement of the pupils, the problem of adjusting the tasks to be accomplished to the stage of development of the child. The educator must know the facts of genetic psychology as they relate to the mental growth of the infant and of the child. From these facts he draws the various pedagogical inferences constituting "educational psychology." The educator must know, also, the fundamentals of adult psychology and from these fundamentals he draws additional inferences of a pedagogical nature. One of the most important problems of experimental education is to discover some means of distinguishing mental abilities or differences in intellectual capacity. To this end, the educator must know the methods and devices to be found in the psychological laboratory. He must, moreover, devise new instruments and new methods applicable to the distinctive problems set by educational practices.[1]

Education and Genetic Psychology

This is neither the time nor the place to write a monograph on educational psychology; but we should have to do this if we were to indicate in any degree whatsoever the wide range of facts which fall to this chapter on applied psychology. He who would help to direct the growing intellectual life of a child or add to its store of knowledge must know how behavior patterns and correlative forms of mental life come into being. It is one of the large tasks of educational psychology to draw such inferences from genetic psychology, from the field of learning and habit, and from as many other fields as will make education an efficient process.

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[1] Read Cameron, E. H., *Psychology and the School*, 1922; Starch D., *Educational Psychology*, 1927; Thorndike, E. L., *Educational Psychology*, 1913 (3 vols.).

Original Nature of the Child.—Education implies a process of growth and growth implies a starting point. We have already found out that original nature is the starting point for the child. Most surveys of educational psychology begin, therefore, with an account of the original nature of the child. It is an account far more elaborate and factual than that reviewed in Chapter VII, but if the reader will recall some of the paragraphs of that chapter he will know the direction in which the educational psychologist is working.

There is, as yet, no agreement on the amount of inherited capital which the child has at his disposal as he begins to grow intellectually. Estimates run all the way from Watson's three emotional reaction patterns (fear, anger, and love) to lists which contain such items as instincts or tendencies toward food-getting and hunting, teasing, ownership and collecting, fighting, motherly behavior, gregariousness, desire for approval and display, rivalry, imitation, sex, and so on.

The study of original nature has always been handicapped by the persistent habit of child observers to name anything in child behavior, the origins of which they have not seen, an instinct. The burden of recent criticisms against the instinct theory is this: children are born with certain tendencies toward very simple reaction patterns, and the nature of the environment quickly molds these simpler patterns into more complex patterns which appear, by the very rapidity of their formation, to be unlearned and therefore instinctive. It is obvious that the answer to all of the disagreements in this field lies in the laboratory, with its experimental technique, and that reader of this book who is anxious to make himself known in psychology could do no better than to devote himself to an experimental program of this type. His contribution would be welcome not only in pure psychology but in educational psychology as well.

Maturation.—Given a start, given some sort of original nature, and growth begins. We commonly think of this growth as due to learning; but we are now finding out that a part (how large a part is yet to be determined) is due to maturation, that is, to the natural maturing of behavior patterns without any particular tutelage. Some of the problems of maturation have been concealed in times past by the statement that instincts are timed. The sex tendencies, for example, are timed in the sense that sex behavior patterns do not ripen until twelve or fifteen years have passed. The significant point is that these behavior patterns and all the emotions and other changes in mental life that go along with them represent a real ripening of the organism and not a process of learning in the usual sense of the word.

Now we do not know how far this process extends. A child "learns" to walk, partly by acquiring new behavior patterns, partly by modifying old ones, and partly by the maturation of the nerve elements involved. Chicks that have been withheld from grain for two or three days after their brothers and sisters have been practicing the art of pecking at food, acquire, within a very short time, equal skill with the others. That is, skillful pecking has matured even without practice. The question which educational psychology must answer, then, is: What part of intellectual growth in the child is due to maturation of central nerve patterns and what part is due to learning? Here is another open field for the experimentally minded reader!

Learning.—In spite of original nature and in spite of all that maturation can do, any child is pitifully inadequate to cope with existence without acquiring new skills, storing up immense amounts of knowledge, and acquainting himself with the culture of his fathers. Learning is one of the greatest phenomena in the world of nature. To acquire a new skill, to be able to recall a learned fact, to become educated! this is one of the distinctive marks of humanity.

Because of the all-powerful influence of learning it is natural that half or more of every text on educational psychology treats of the laws and principles of learning. Except as these laws and principles have been suggested in previous chapters, they will be left out of account.

Meeting the Child Halfway.—The newborn infant does not begin his first meal on earth with a beefsteak smothered in onions. His digestive system grows up to heartier foods and no one is overly anxious to push his diet too fast. There was a time, however, when feeble minds were fed with intellectual food as hearty as the beefsteak. No wonder one man could boast of 911,500 canings!

It is just at this point that experimental education and genetic psychology can celebrate one of their greatest triumphs. Men have found out how to meet the growing child with an educational program adapted to its intellectual level.

It will be recalled from Chapter VII that the period of intellectual growth in the child can be divided into five phases. The first period was called the pre-social period, a period in which rapid growth of the body and great changes in the nervous system are still taking place. During the first year the child is not yet physically complete. His nervous system is not fully developed and his sense organs and many of the muscles are undeveloped. The inference is drawn, then, that the health of the infant is the most serious problem to be attended to during the first year. If, at the end of the year, he is to begin to acquire an education, his nervous and physical equipment must, by that time, be in the best possible condition.

Toward the end of the period muscular coördination and the perfection of his receptors make it possible for the child to begin his examination and manipulation of the world about him. "In this period of rapid growth and great physiological changes the most important consideration is health. This is greatly emphasized by statistics which show that about 11 per cent of children die during this period, whereas but 2½ per cent die in the second period and less than 1 per cent in the third year, while in the sixth year the death rate is little more than one-third of one per cent and in the twelfth, but one-sixth of one per cent. Physical welfare should therefore be the chief care during the first year. It is during this period that the disastrous results of the belief that children are just like adults, only smaller and weaker, have been most marked. The child who is treated as regards food, sleep, and medicine as if he were like an adult must be exceptionally strong if he survives. . . . As soon as he can move his hands he should not be amused wholly by what others do, but rather by what he can do, to objects and with them. Others may do things that lead the child to discover new possibilities in objects but they should not long at a time manipulate objects for his amusement. By so doing they interfere with his own educative play activity and hinder his finding out the real qualities of objects and his own powers in relation to them. As has elsewhere been indicated, the power of varied manipulation of objects for different purposes is what gives the child an advantage over any animal in the formation of free ideas. His mental development is therefore best favored by allowing him, during this period, plenty of opportunity for such manipulation. . . . The principles of novelty should be made much of at this time. None of the child's playthings should be with him all of the time, but those not in use should be placed out of his sight for awhile, as soon as he loses interest in them, then restored to him again when they will arouse his interest anew."[1]

Successive stages in the development of personality and intellect have led to inferences of a parallel nature. The inability of the child in the second period to reason for itself warrants the assumption that instruction must depend upon appeals to the senses and to that which is inherently interesting. During the early part of this period the child is much like the higher animals whose mental life is almost wholly perceptual. The whole period should be spent in exercising the apprehensive capacities and giving to the child as wide a range of knowledge as he can get. The development of the capacity to imagine and to reconstruct objects toward the end of the period can be used to the same purpose. "It is in this period that more complex and instinctive imitations are made and with greater accuracy. Tones of voice, laughing and crying, frowning, and many other expressions of the face are imitated. . . . In this kind of imitation of instinctive sounds and movements, the child is only a little more ready than animals, while in the tendency to imitate new movements he differs greatly from them. They have little or no tendency of that kind while he has it to a marked extent."[1]

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[1] Kirkpatrick, E. A., *The Individual in the Making*, 1911, pp. 68–69.

In contrast to the curricula of a generation ago in which formal subjects were set for instruction in each of the grades, instruction now is determined by the psychological characteristics of the child at each level of its development. Since the third period is characterized by the readiness with which habits may be developed, habit-formation is the chief thing. The first habits to be established are the language habits and the skill of the child in this direction is shown by the fact that its vocabulary grows at an amazing rate. For all of the earlier years passive attention predominates over the other two stages and the individual is not ready, accordingly, to establish his own habits or to formulate his own interests. The teacher must help him.

Even when the child is ready to take up formal instruction in the grades—it is presumed that much of his training to date has been by the "project" method, directed by his parents or by a teacher in a kindergarten—he is hardly able to choose wisely his own interests. Moreover, the four walls of a schoolroom do not lend themselves to the development of the functions which are at their highest level during this time, viz., the apprehensive functions. Many ways have been devised to overcome this difficulty under the belief "that what the child is, and the conditions, materials, and activities most favorable to his developing into what it is desired he shall become, shall determine the course of study in each stage of development, rather than the ideal of what the mature man needs to be, know, or do."[1]

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[1] Kirkpatrick, *op. cit.*, p. 73.

"During the ages from nine to twelve, which usually cover grades three to six, the aim should be to perfect the child's knowledge of symbols and give him facility in their use, and to introduce him to a wider environment of men and things as they are described in history and geography. . . .

"The intellectual activity which may be best used and trained during this period is the imagination. In the preceding period it should be kept active in a more or less playful way, but in this period it should be directed and controlled in accordance with realities. That is, the child should be trained in picturing absent objects and unwitnessed events as set forth in words, as they actually are and were. The child is no longer to picture solely according to fancy, but according to descriptions. . . .[2]" The development of memory from six to nine makes it profitable to give him a large number of facts which are fundamental to further work.

In the later stages of development the problem of education is much easier, for the child rapidly acquires all the capacities belonging to adulthood. The development of voluntary attention, of voluntary memory, of the capacity to make abstractions, and therefore, of the ability to set tasks for himself and find his own interests, lightens the burden of the teacher and adds greater purpose to the educational process.

Individual Differences in Education

The problems which we have just been discussing were among the first to appear when experimental education began to take itself seriously. These problems have now taken second place, however, in favor of the construction and application of mental tests. The history of the development of these tests is relatively short. They originated with two Frenchmen, Alfred Binet and Theodor Simon. We do not mean to imply that the possibility of measuring intellectual capacity had not arisen before, but it fell to Binet and Simon to create the first workable scheme of measurement.[1]

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[1] Kirkpatrick, *op. cit.*, p. 280.

[2] *Ibid.*, pp. 293–294.

The Measurement of Intelligence.—That such tests might be valuable had been suggested early in the last century by writers interested mainly in the classification of inferior children. The modern methods of testing intellectual talent were first suggested by Sir Francis Galton who, as we have already found, spent considerable time upon the problem of individual and racial differences. Galton's methods of obtaining individual differences were open to error, for he depended largely upon his own observations and upon questionnaires. His observations were supplemented, however, through studies by Kraepelin, in Germany, on the mental differences between the normal and the insane and by Cattell, in America, on students entering Columbia University. Studies of a similar nature excited the critical interest of Binet and Henri in France and out of this interest came the formulation in 1905 of the Binet-Simon tests. The immediate occasion of the tests was the request in 1904 of the French Minister of Public Instruction that classes for subnormal children be organized in the public schools of Paris. To select these children was the aim of the first studies. The original tests of 1905 were improved and republished in 1908. A year later they were translated into English and improved by Goddard and through this medium they found a generous welcome in America. There were, of course, a good many imperfections in the tests, and educators in this country went to work revising and remodeling the old or actually constructing new tests. The most important revision has come to be known as the Stanford Revision.

The original tests and most of the tests that have been constructed since then are devices for measuring some sort of intellectual accomplishment or capacity. "Subjects are asked to execute simple orders; to name familiar objects; to repeat short series of digits and short sentences; to compare lengths and weights; to count, naming pieces of money and making change; to define familiar, concrete terms and abstract terms; to point out similarities in the meaning of two words; to point out differences; to tell what they see in a complex picture; to copy geometrical figures or reproduce them from memory; to tell what ought to be done in various situations; to put together the words of a dissected sentence so that they make sense; and to recognize absurdities." [1]

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[1] Read Freeman, F. N., *Mental Tests*, 1927.

Now, under measures of capacity, the differences between children were found to be much greater than the similarities. In fact, the differences were discovered to be much greater than was ever supposed, for in an unselected group of pupils the best pupil might be able to accomplish from two to twenty-five times as much as the poorest.

The range of differences between pupils can be seen in the following table. Among thirty-six pupils in the eighth grade the best and the poorest performances stood as follows:[2]

TABLE VI

	Best	*Poorest*	*Ratio*
Reading—Speed	6.6	1.8	1 : 3.7
Reading—Comprehension	76.0	22.0	1 : 3.5
Writing—Speed	108.0	57.0	1 : 1.6
Writing—Quality	90.0	6.0	1 :15
Arithmetic—Reasoning	15.0	2.0	1 : 7.5
Arithmetic—Addition	15.0	1.0	1 :15
Arithmetic—Subtraction	17.0	2.0	1 : 8.5
Arithmetic—Multiplication	17.0	1.0	1 :17
Arithmetic—Division	16.0	2.0	1 : 8
Spelling	90.0	45.0	1 : 2
Composition	70.0	30.0	1 : 2.3
Grammar	13.0	6.0	1 : 2.9
History	104.0	4.0	1 :26
Average			1 : 7.6

These discoveries made it exceedingly difficult to retain the old idea of types. Modern education has, instead of types, a distribution curve. Approximately two-thirds of mankind fall into the middle section of the distribution curve and the remainder are equally divided into superior and inferior groups.

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[1] Woodrow, H., *Brightness and Dullness in Children*, 1919, p. 23.

[2] Starch, D., *Educational Psychology*, 1927, p. 36.

This sort of distribution, curiously enough, is characteristic of biological as well as of psychological traits. Chance events are distributed in the same manner, and it is because of this last relation that modern experimental education has employed, so liberally, the mathematics of chance distributions and of correlation.[1]

The measure of the degree of correlation aims to answer such questions as: To what extent is a good memory accompanied, in the same person, by an equally good capacity for the exercise of any other intellectual talent? Correlations, as we have found, are indicated along a scale from zero to one. Zero implies no correlation while 1 indicates complete correlation; 30 or less is not a significant correlation. Under certain conditions, 30–.50 may be significant; but preferable values lie above .50 or .60.

When degrees of correlation are worked out for different talents, for performances in school work, and for the relations between these two, it appears that the pupil who is good, mediocre, or poor in one ability or in one school subject is apt to be good, mediocre, or poor to very nearly the same, but not equal, extent in all other abilities or school subjects. Differences that do exist are often explainable in terms of interest or industry or other conditions surrounding school life. As a general rule, high ranking in special mental capacities implies high rank in general intelligence.

Tests of intellectual talent have found their greatest value in helping educators to distinguish children of different abilities and to segregate them accordingly. It was soon realized that an unselected group might be seriously retarded by the pace of the inferior members of that group. To this end, certain devices are used to designate degrees of ability, the commonest being the Intelligence Quotient (the I.Q.) or some equivalent. The I.Q. is a quotient which represents the relation between the mental age and the chronological age of a child. It is obtained by dividing the former by the latter and multiplying by one hundred. Thus a child ten years old with a mental age of ten would have an I.Q. of 100, a child of ten years with a mental age of twelve would have an I.Q. of 120, and so on.

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[1] Garrett, H. E., *Statistics in Psychology and Education*, 1926.

On the basis of the information which is at hand from these and other sources Starch has been able to make the following significant summary of individual differences as applied to school work.[1] With respect to a school population as a whole, one may say that:

1 pupil	in	100	could	finish	the	8	grades	in	4	yrs.	or	at	10	yrs.	of	age.
2 pupils	“	“	“	“	“	“	“	“	5	“	“	“	11	“	“	“
9 “	“	“	“	“	“	“	“	“	6	“	“	“	12	“	“	“
21 “	“	“	“	“	“	“	“	“	7	“	“	“	13	“	“	“
33 “	“	“	“	“	“	“	“	“	8	“	“	“	14	“	“	“
21 “	“	“	“	“	“	“	“	“	9	“	“	“	15	“	“	“
9 “	“	“	“	“	“	“	“	“	10	“	“	“	16	“	“	“
2 “	“	“	“	“	“	“	“	“	11	“	“	“	17	“	“	“
1 pupil	“	“	“	“	“	“	“	“	12	“	“	“	18	“	“	“

PSYCHOLOGY OF LEARNING

Except for the changes that are due to maturation all that occurs from infancy to adulthood reflects in one way or another upon the problems of learning. The books on educational psychology often distinguish between the problems of learning taken in the large and problems of learning as they are applied to the ordinary school subjects, that is, to reading, handwriting, spelling, language, arithmetic and history.

Transfer of Training.—There is no need, in this book, of detailing the enormous number of facts which have been discovered about the most economical method of learning.[2] We know that the normal learning curve rises slowly at first, then more and more rapidly and finally flattens out to a plateau which marks the practical limit of skill of the average person. In most learning problems the subject of the experiment approaches the problem with some knowledge or some useful skill and the initial slow rise of the normal curve is masked by the great measure of initial progress.

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[1] Starch, D., *op. cit.*, p. 41.

[2] Consult Pyle, W. H., *The Psychology of Learning*, 1921.

This fact has introduced to experimental education a problem which has not often been surpassed in difficulty. This is the problem of the transfer of training. The fact that most individuals hit the learning curve at a point well beyond its starting place suggests that skills and habits may be carried over from one situation to another. The experiments which have been performed upon this problem seem to admit of the following summary. (a) Most of the experiments show that improvement in one talent or group of talents is accompanied by an improvement in related talents. (b) The transference is usually positive, that is, other talents gain in perfection, but instances of interference are not infrequent. This is true, in particular, of simple motor skills. (c) The nearer two groups of talents resemble one another the greater the amount of transference but rarely is the amount of transference greater than twenty or thirty per cent. The more unlike the talents the smaller the amount of transference, the amount standing at zero for talents which are wholly unlike.

Of the theories that have been advanced to explain transfer of training we mention only two, viz., the theory of identical elements (Thorndike) and the theory of generalized experience (Judd). The first theory is illustrated by the fact that practice in addition will increase one's skill in multiplication, presumably for the reason that one of the necessary operations in multiplication is addition. The second theory is illustrated negatively by the child that could count the fingers on its own hand but not the fingers on the hand of the father. "Fiveness" was not something that had been detached from fingers. As the child grows older, however, generalizations of this kind are of frequent occurrence. The presumption is that if we develop habits of initiative in playing football we ought also to take an initiative in playing basketball.

It is in the application of these facts to school subjects that difficulties and uncertainties arise, for the amount of transfer in such material seems almost negligible. The reasons for this are unknown but it is thought that the very general nature of many of the school subjects makes it impossible to reduce the problem to an experimental and therefore to a controllable basis.

Psychology and the Curriculum.—Modern experimental education has sought, also, to psychologize the several branches of elementary instruction. The world of the adult is too complicated to be understood by the child without being simplified. The modern infant, left to itself, would hardly do better in understanding it than the adult belonging to prehistoric groups. His causal relationships would be perverted, his judgment inadequate, and his behavior with respect to it uneconomical. The social heritage, in particular, is much too involved to be taught without being simplified. Languages, the sciences, the arts, are all products of adult minds and one of the large tasks of experimental education is to work over this material and to put it in such a form that the immature mind can encompass it. Tradition has, of course, brought to the curriculum the three "R's" and other contents supposedly adapted to early training, and the task of reorganizing the products of mature intellects to fit the capacity of immature intellects must include, therefore, an analysis of these traditional contents of the curriculum.

For example, the description of the perceptual processes and of the psychological principles involved in reading, writing, and arithmetic and in other parts of the curriculum has materially increased the availability of these subjects in the lower grades. In reading, studies have been made upon the perception of printed words, the relation between perception and meaning or recognition, the dependence of reading upon a prior learning of the alphabet, the motor processes in the vocal apparatus during reading, the importance of imitation in pronunciation and enunciation, the respective values of oral and silent reading at different ages, the establishment of associative bonds between visual or auditory symbols and meanings, the dependence of the sense of what is being read upon the rate of reading and upon mental age, and the measurement of different capacities for reading.

In writing, to take another illustration, the child has to learn by trial and error to eliminate useless movements and this process depends upon certain psychological principles. Studies on writing suggest that it is more advantageous for children to learn first to write words instead of single letters. Other studies have been made upon the muscular coördinations involved in writing, methods of holding the pen, arm movements as opposed to finger movements, the relation between speed and good form in writing, and so on.

Arithmetic has aroused a great deal of discussion, for it is alleged that the ability to use numbers is closely related to the nature and use of abstract thought. Studies in this field have been directed toward the relation between counting and marking down tallies or putting objects and symbols in a related series, the psychological conditions underlying the fundamental arithmetical operations, the relation of the early number ideas of children to number systems, the methods of establishing "the multiplication tables," the analysis of problem-solving, and the like.

CHAPTER XX

PSYCHOLOGY AND LAW

Introduction.—The serious application of psychological facts and principles to legal problems has been held back by extravagant statements and beliefs which have done considerable injustice to the science. The "third degree" methods of criminal courts and detective bureaus have been falsely attributed to the use of important psychological laws, and the conduct of a few lawyers in their appeal to the emotions of a jury has often been misinterpreted as involving more subtle mental conditions or as being based upon good psychological practice. The clever turns of a cross-examination, the "mental atmosphere" produced by "exhibits" and by critical periods sometimes called "the psychological moment," the influence upon the jury of the emotions expressed by relatives of the victim of a crime, and many other courtroom events of like nature, have been magnified in the popular press and they have given to the psychology of legal problems an unwholesome flavor. The observations of reporters and courtroom followers are correct, however, in so far as they emphasize the mental factors in legal practice, for psychotechnology treats of a number of important problems in this field. The psychology of testimony and of deception, the effect of instruction upon juries, pleading, and problems of a similar nature fall here.

Law and Individual Differences.—In the last analysis the problems of this chapter rest, as they did in the field of education, upon a psychology of individual differences. Judges, juries, lawyers, criminals, and witnesses all present wide variations in every form of human talent. The judge, for example, reserves the right, within certain limits, to determine the length of a sentence. Observations and statistics show that this decision is, to a high degree, dependent upon the psychological preference of an individual judge for certain round numbers. In 1890 there were 63,653 prisoners serving term sentences in our prisons. When the terms of commitment were plotted in an appropriate manner it was discovered that they were "determined in a marked degree by the judge's preference for round numbers in years, and for quarters of years in months. There are, of course, many gradations of judgment made, presumably, to meet the ends of justice. But the preponderant number of terms for 1, 2, 3, 5, 7, 10, 15, and 20 years, and for life, and the strong preference above 4 years for 10 years indicates a mental habit which the bench is subject to. . . . It is impossible to believe that a judicial system acts fairly which, when it allots only 20 sentences to 6 years' imprisonment, allots as many as 240 to 5 years, as few as 60 to 4 years, and as many as 360 to 3 years. Or that, while there are 20 sentences to 19 months, there should be 300 to 18, none to 17, 30 to 16, and 150 to 15."[1]

Juries differ widely from one another. Retrials, making use of approximately the same evidence, the same lawyers, and the same judge, may result in the reversal of a decision or change a "locked" jury to one for acquittal or conviction. Juries vary in their susceptibility to the emotions of a lawyer, in their appreciation or comprehension of instructions, in their ideals of honor or justice, in their sympathy for individuals, in their susceptibility to the unwritten law, to race hatreds, to the promptings of gallantry, to temperaments, and in their ability to weigh or to be influenced by evidence and the arguments built upon evidence. The individual members of a jury are especially variable as regards their appreciation of arguments.

The influence of this one factor upon their deliberations is illustrated in the following experiment. Upon sheets of dark gray cardboard were pasted white paper dots of different form and in an irregular order. Each card had between 92 and 108 such white dots of various sizes. The task was to compare the number of spots on one card with the number of spots on another. Eighteen subjects sat around a table and were allowed to look for a minute and a half at two cards. At the end of that time and at a signal each wrote down his judgment as to which card held the largest number of dots. The "jurors" were acquainted with the ballot and then they were allowed to discuss the question. Many different aspects of the problem of perception, for example, were brought to bear upon one side or the other. After five minutes a second vote was taken. Another five-minute period of argument was allowed them and then a third and final vote was recorded. As a result of the experiment it was discovered that 52 per cent of the first votes and 78 per cent of the final votes were correct. Obviously, the final judgments of this jury had been rendered, in a good many cases, upon other factors than the original perception. The part which these "other factors" play varies, as we said, with the individual. A similar experiment conducted with a female jury, showed that the percentage of correct votes remained constant in spite of the five-minute periods of discussion. There were, of course, changes in the judgments offered; but changes to the negative were, in the case of the women, always compensated by changes to the affirmative. That is to say, 40 per cent of the judgments of the men but only 19 per cent of the judgments of the women suffered change between the first and the third vote.[1]

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[1] Coover, J. E., *Experiments in Psychical Research*, 1917, pp. 234 ff.

Lawyers, likewise, differ from one another in respects that bear directly upon their profession. These differences have not, however, been brought under experimental conditions, and we must be satisfied, temporarily, with two or three gross differences. Common observation seems to suggest, for example, that some lawyers proceed logically in the development of their cases, while others depend upon their ability to excite emotions and prejudices in the minds of their juries. Still others appear to depend upon their descriptive abilities, for they take great care to reconstruct in the minds of jurymen the actual scenes and occurrences of an alleged crime. Lawyers of the logical type argue with the jury. The emotional type frequently storm at their juries and induce, at times, almost a mobbish emotionalism among the members.

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[1] Münsterberg, H., *Psychology and Social Sanity*.

The Problem of Testimony

The Psychology of Testimony.—One problem has been submitted to serious experimental analysis, viz., the problem of testimony. The report of a witness involves, of course, a very large number of psychological conditions and all of them are susceptible of variations that make truthtelling a serious problem. It is possible, for example, that the original perceptions may have been inadequate or that the significance of the perceptions was lost. Furthermore, the neural dispositions underlying memory images may have changed in the course of time so that a correct reproduction has become impossible, or the intent to tell what one does remember may not be intense enough to overcome suggestions or to secure completeness of recital. Finally, the witness may lack the ability to express his ideas correctly, for language is often double-faced. Only if the process of getting information is free from disturbances at all these points can the testimony count as a reliable report.

The whole matter of testimony can best be described by appealing in detail to an actual experiment.[1] The conditions of the experiment were arranged as follows. Four hundred students were used as subjects. The group was assembled as usual in a lecture room. Upon the lecture desk, which ordinarily held several demonstrational pieces for lectures in chemistry, there was placed a stand holding two flasks, an upper one with blue liquid connected by a tube and stopcock to a lower one containing yellow liquid. Leading to the left of the lower flask was a tube which emptied into a third flask holding red liquid and this was connected in turn through a large tube of calcium to a fourth flask which contained violet liquid. The whole apparatus was set well toward the front of the desk; but running backward and unobservable by the lecture group was a rod against which the lecturer might easily move.

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[1] From a hitherto unpublished experiment by the author.

The following plan was laid and rehearsed before the lecture hour. The lecturer was to begin his discussion as usual; but within a quarter of an hour after the introduction he was to move, as if by accident, against the rod and so push over, toward the audience, the apparatus that had been set up. A student had been instructed to call out loudly, just as the apparatus fell over, "Look out!" After the crash a demonstrator was to *walk* into the room and the following conversation was to take place:

DEMONSTRATOR: What has happened here?
LECTURER: I am very sorry; I had an accident.
D (*excitedly*): I don't see why you psychologists can't give a lecture here without breaking our demonstrational apparatus.
L (*with vigor*): It was very stupid of you to put it in the middle of the desk.
D (*exasperated*): I had it all arranged for the next lecture hour.
L (*with asperity*): Well, I can't trouble with it now. You are interrupting my lecture.
D (*angrily*): That makes no difference. You have broken our apparatus and you must pay for it.
L (*dignified*): Please do not interrupt me longer.
D (*very angry and excited*): You people will have to find another lecture room. I will not have my apparatus broken down.

Toward the last of this conversation the audience, wholly in sympathy with the lecturer, and quite naïve in the whole matter, began to shout "Get out," "Take him out," and the like. Assistants held stop-watches in order to time the incident.

After order was restored a number of questions were put to the group, with the request that they set down opposite their answers the figure 3 if they were very sure they were right, the figure 2 if they were reasonably sure, the figure 1 if they were doubtful, and 0 if they were guessing. The questions together with illustrative answers of grades 2 and 3 were as follows:

1. What time is it?

   The lecture began at 9 o'clock. At 9:14 the incident above described took place. The estimated time varied from 9:10 to 9:35. Eighteen people were confident that the time was 9:10, 3 insisted upon 9:12, 4 upon 9:14, 67 upon 9:15, 2 upon 9:17, 40 upon 9:20, 16 upon 9:25, 10 upon 9:30, and 1 upon 9:35. There was a greater tendency among the women to overestimate the time.

2. How many people participated in the incident?

   There were actually three, the lecturer, the demonstrator, and a student. The estimate of the subjects varied from 2–9; 71 people insisted upon 2, 149 upon 3, 11 upon 4, 2 upon 5, 3 upon 6, and 4 upon 9. There were a large number of guesses for 2 and 3.

3. What colors were the liquids in the flasks?

   It will be recalled that there were four different colors, viz., blue, yellow, red, and violet. Eleven colors were actually named. Pink, blue, purple, red, orange, green, white, yellow, brown, cream, and crimson make up the list.

4. Did any one call a word of warning?

   A student had been primed and just as the apparatus fell he called loudly "Look out!" Two hundred fifty-nine persons were sure that a warning had been given; 11 people "guessed so." There were no denials, presumably because of the suggestive form of the question.

5. What color was the tie worn by the demonstrator?

   The tie was dark with very small blue, red, and green lines. At a distance of 10 feet the tie appeared homogeneous and almost black. The tie was alleged by the subjects to be blue, black, dark, red, brown, and green. Seven were sure that he wore no tie.

6. Did the demonstrator run or walk into the room?

   He walked. Forty-five insisted that he ran, 210 were sure he walked, 31 guessed that he walked, and 18 guessed that he ran.

7. Did the demonstrator appear angry?

   He endeavored to look non-committal. Two hundred thirty-six individuals insisted that he was angry and 6 guessed so. Only 14 were sure he was not angry.

8. How many seconds elapsed during the incident?

   The actual time was 38 seconds. The estimated times ran all the way from 10 seconds to 200 seconds. Five insisted upon 10 seconds, 5 upon 15 seconds, 6 upon 20 seconds, 8 upon 25 seconds, 21 upon 30 seconds, 2 upon 35 seconds, 12 upon 40, 11 upon 45, 8 upon 50, 2 upon 55, 32 upon 60, 1 upon 65, 3 upon 70, 2 upon 80, 4 upon 90, 1 upon 100, 6 upon 125, 2 upon 150, 4 upon 180, and 1 upon 200.

9. What did the lecturer do immediately after the apparatus fell?

He straightened the towel upon the lecture desk. Sample answers were: "He got embarrassed." "He said the lecture for Monday would be on testimony." "He leaned over the table and looked at the wreck." "He smiled." "He resumed his lecture." "He looked foolish." "He looked perplexed." "He recoiled in dismay."

10. How many pieces of glassware were broken?

Two pieces were found broken. The estimates (based, presumably, upon auditory perceptions and imaginal processes) ranged from 1 to 10. Six insisted upon 1, 29 upon 2, 37 upon 3, 26 upon 4, 5 upon 5, 4 upon 6, 1 upon 7, 2 upon 8, and 2 upon 10.

11. How high did the apparatus stand upon the desk?

The actual height was 22 inches. The estimates varied from 12–36 inches. Ten were certain of 12 inches, 2 of 14, 2 of 15, 40 of 18, 11 of 20, 65 of 24, 38 of 30, and 21 of 36.

12. Was the apparatus a complex piece?

Compared to the demonstrational pieces usually appearing upon the same desk, the apparatus was fairly simple. Two hundred seven insisted that it was complex and 77 that it was not complex.

13. Did the lecturer appear bothered or embarrassed by the accident?

He endeavored to be non-committal. Two hundred twenty-nine were sure that he was embarrassed and 74 insisted that he was not.

14. Did the demonstrator wear a coat?

He wore a white laboratory coat. Nine individuals were sure he did and 286 were sure he did not.

15. Did the lecturer try to catch the falling apparatus?

He found that he had at first failed to push it over. As it was just about to fall he reached across the desk and pushed it over. Seventeen affirmed that the lecturer did try to catch the apparatus and 201 insisted that he did not touch it.

16. How tall was the demonstrator?

His actual height was 5 feet, 10 inches. The estimated height varied from 5 feet to 6 feet, 2 inches. Two affirmed that his height was 5 feet; 1, five feet, 1 inch; 1, 5 feet, 2 inches; 2, 5 feet, 3 inches; 5, 5 feet, 4 inches; 9, 5 feet, 5 inches; 24, 5 feet, 6 inches; 24, 5 feet, 7 inches; 29, 5 feet, 8 inches; 21, 5 feet, 9 inches; 13, 5 feet, 10 inches; 11, 5 feet, 11 inches; 5, 6 feet; 6, 6 feet, 2 inches.

17. From what part of the room came a woman's cry as the apparatus fell?

There was no cry. The following phrases were used in describing the location of an alleged cry. Right front, back center, left front, right, east side, west side, front, about six rows back, right hand corner, back of room, third row center, several parts of the room.

18. Was there any rubber tubing on the apparatus?

There were three small pieces (2 inches) and one long piece (12 inches). Sixty-two insisted that there was some rubber tubing and 56 insisted there was no rubber tubing.

19. Put down as faithfully as you can what was said by the lecturer and the demonstrator after the latter came into the room.

The exact conversation has already been given. The following are a few samples of the alleged conversation.

(*a*)

D: Why don't you watch out what you are doing? Here I had all that set up for the next lecture.

L: I am very sorry.

(*b*)

D: Can't you give a lecture here without breaking my apparatus?

L: I'm sure it was just an accident.

D: Well, I had it all fixed up for a lecture next hour.

L: I'm very sorry indeed. I wish you would leave it rest for a few minutes and leave the room.

(*c*)

D: Look out! I had that fixed up for a lecture the next hour. Can't you lecture in here without breaking up the apparatus?

L: I am very sorry. It was an unavoidable accident. Can't you see you are holding up the lecture? What? All right I will see that it is fixed up.

(*d*)

D: Say, can't you give a lecture here without busting something?

L: I'm very sorry.

D: Can't you lecture in here without knocking down my apparatus? Now I was going to use that next hour. You'll have to pick it up. No—don't wait until afterwards—do it now.

The experiment we have just described illustrates the problem which confronts a court when it attempts to search out and verify the evidence in a case. It is clear from our results that this accident could have been taken into two different courts and, with a proper selection of witnesses, two entirely different decisions rendered. Had the conversation resulted in a fight or a killing it would have been possible, by choosing certain witnesses, to show without a shadow of a doubt that the lecturer had taken the initiative. Or, again, the initiative might just as easily have been laid at the door of the demonstrator.

The tendency to estimate distances and times in round numbers is illustrated in each of the cases included in this experiment. The data from the experiment show, also, the influence of expectation upon observation. This influence underlies, apparently, the tricks of the conjurer. He sees to it that the convictions of a person are leaning in a given direction and then he finds it a simple matter to persuade an individual to see or to hear *more* or *less* than is actually present. In our own experiment, for example, it seems clear that the belief that the demonstrator ran into the room, and the judgments of the emotional attitudes of the demonstrator and the lecturer were affected by what the subjects in the experiment naturally expected from such a situation. Expectation, however, is of positive as well as of negative value, for a description of an event we are anticipating is apt to be more accurate than the description of unlooked-for events.

The Reliability of Testimony.—Other studies on the reliability of testimony have given the following facts. In the first place, two forms of report have been distinguished, viz., (*a*) the interrogatory form, and (*b*) the narrative form. The first form of report depends upon questions and answers. It yields, according to various estimates, approximately 65 per cent of the objects and events originally experienced. Of these objects and events about three-fourths are correctly recalled.

The narrative type of report follows such an instruction as: "Tell the jury what happened on the day of the accident." This type of report yields—under certain conditions—only 40 per cent of the events which actually occurred; but it is more accurate than the interrogatory form. Narrators fall into four groups with respect to the type of report they give. Those of the observational type give a running account of their experiences during the period under scrutiny and they may get as much as a third of their report correct. Those of the cataloguing type throw their recollections into classes and subclasses and present them under appropriate headings. Their report may be 27 per cent correct. The emotional witness gives 24 per cent of his testimony correctly. The erudite narrator is least reliable of all. The term does not apply to professional testimony or to reports by men of science, but to those individuals who strive to philosophize or to speculate upon events when they have not had the preparation necessary to such reflection. Testimony of this sort is trustworthy to the extent of only 3 per cent. Whether these percentages, which are drawn from fixed experimental conditions, reflect the distribution of observers in a courtroom is a matter that must wait upon further experiment. They are, however, suggestive of what may later be discovered.

The errors in the interrogatory type of report issue, as we have said, from a number of factors. It is possible that the original perception was defective or inadequate; or that the temporal intervals may have been misjudged; or that the memory residues may have changed enough to limit accurate recall; or that the intention and instruction to recall has not been great enough to overcome associative filling in and the desire to tell a good story; or that the individual lacks the verbal form of expression for conveying his ideas properly; or that the form of question put to him has been suggestive or misleading. All of these possibilities must, of course, be experimented upon.

The Form of a Question and Reliability.—A number of studies have been made on the influence which the form of a question has upon the reliability of the answers. The following descriptive phrases were used in one experiment to distinguish various types of question:[1]

(1) The determinative question form ("The question with the question word"); *e.g.*, What color is the shirt?

(2) The complete disjunctive question form; *e.g.*, Is the child in the meadow asleep or awake?

(3) The Yes-No question form; *e.g.*, Is there a cupboard in the room?

(4) The No question form; *e.g.*, Might the man have a spoon in his hand?

(5) The Yes question form; *e.g.*, Isn't there a cupboard in the room?

(6) The incomplete disjunctive question form; *e.g.*, Is the shirt red or green? (It may be either but it may be some other color.)

(7) The implicative question form (questions with false implications); *e.g.*, What is the child in the meadow doing? (This implies (*a*) that there is a meadow; (*b*) that there is a child in it.)

When the questions are actually put to a large number of individuals who are observing under controlled conditions, the answers reveal a number of important facts. For example, changing the indefinite into the definite article in a question form decreases suggestiveness, caution, and reliability in the answers. Introducing the negative into a question increases suggestiveness and decreases caution and reliability. Including both the definite article and a negative in a question decreases the suggestiveness of the question as compared to that containing the indefinite article and a negative, but increases the suggestiveness with respect to a question containing the definite article and no negative. It also increases the caution and the reliability of the question. The implicative type of question is lower than all other forms for suggestiveness, caution, and reliability. The incomplete disjunction question form possesses a relatively high suggestiveness, a relatively low caution, and a relatively low reliability. Other studies show that repeated observation or practice in observation increases very materially the reliability of evidence.

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[1] Muscio, B., "The Influence of the Form of a Question," *Brit. J. of Psychol.*, 1916, Vol. 8, pp. 351–389.

Other Psychological Factors in Testimony.—Most of the inadequacies of memory are errors of omission. Under the stress of cross-examination, however, the witness may attempt to fill in relevant material and his errors then become errors of erroneous insertion and errors by substitution. Transpositions in time and in the order or sequence of events is one of the easiest errors into which a witness may fall. They are made all the more vicious because they often pass unnoticed by the observer himself. The court has no right to infer, then, that the correct recall or the attested reliability of a witness in one instance justifies the acceptance of all of his testimony.

Testimony is also affected by the range of attention. Under ordinary conditions the range of consciousness is constricted. That is to say, only a limited number of objects can be apprehended at once. It is clear, then, that events occupying short intervals of time are very apt to be reported inadequately. Other experimental facts about attention are of interest to a court in its evaluation of testimony. In a given situation it is usually the sudden, moving, repeated, intense, or novel objects that are attended to at the expense of many other objects which, in themselves, may be more important to the court than objects like those mentioned.

THE DETECTION OF GUILT

Methods of Detecting Guilt.—A chapter on the relations between psychology and law would not be complete without some account of the devices that have appeared from time to time to detect guilt. Two methods have been mentioned frequently in the public press, one called "the third degree" and the other "the method of diagnostic associations." The third-degree method consists in an attempt to wring from an accused person whose guilt is presumptive a confession of his crime. The accused is closeted with a detective or some other official who strives to make vivid again the scene of a crime and the alleged part played in it by the accused. Questions, suggestions, and threats are hurled at him hour after hour. Objects from the scene of the crime, situations designed to produce fear, and other forms of intimidation rapidly follow. The accused is given no rest over periods of twenty-four or thirty-six hours until finally a confession, in the case of guilt, is literally *wrung* from him. In some cases the method becomes genuinely brutal and it has won little respect, even from the public.

The method of diagnostic associations has had a little better reception, although its actual value is still undetermined. The following experiment will illustrate the main points in the method.[1] Two dark rooms were selected and in one was arranged an alchemist's shop with a dimly lighted skull, chemical apparatus, odors of various kinds, and rustling and sudden noises. In the other, the statue of the Boy and the Thorn was arranged in a pleasing manner upon a dark background. The statue was illuminated by candles. Fifty subjects were selected and asked to choose, by chance, one of the rooms. They were instructed to go, one by one, to the room indicated by lot, to step inside the door, remain for a few seconds, and then to go to the room of the experimenter. The experimenter had, in the meantime, made out a list of 30 words, 10 of which referred to objects in the alchemist's shop, 10 to the statue room, and 10 to irrelevant objects. The subjects were asked to respond, by using the method of paired associates, to this list of stimulus words. The experimenter was prepared to set down the associated word and the time, in thousandths of a second, which elapsed between the stimulus word and the response. Now the method proceeds upon the assumption that the association of words relating to a compromising scene or act will appear more slowly than those following irrelevant words. Under the conditions laid down, and by averaging the association times and considering the character of the associations, the experimenter was able to tell in 47 out of 50 cases to which room the subjects had gone.

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[1] An unpublished experiment performed in the Laboratory of the University of Illinois by Prof. C. A. Ruckmick.

Relation between Lying and Organic Changes.—This method of detecting guilt has been used in a number of instances and has proven successful; but the conditions underlying it are quite unknown and a wide application of the method is as yet doubtful. It is possible that, by using it in conjunction with other methods, it can be made a reliable source of criminal detection. To this end, further checks upon the method have been devised. It has been assumed, for example, that emotionally toned experiences ought not only to determine in one way the formation of associative bonds but to express themselves in motor and organic changes. In the study of feeling, the method of expression rests upon the assumption that affective experiences are accompanied by changes in heartbeat, respiration rate, muscular strength, bodily volume, and the like. By using appropriate recording apparatus such as the kymograph, pneumograph, plethysmograph, and the galvanometer, it is assumed that the organic changes which may occur during the giving of testimony or during cross-examination can be registered. It has been alleged, for example, that the truth or falsehood of an oral statement can be detected by noting the ratio of the length of inhalation to the length of exhalation before and after the statement. The psychogalvanic reflex, an index of the change of resistance of the body during emotion, has also been used as a detector of guilt. It is obvious, of course, that these indices are not measures of the quality of an emotion or of its noetic references; they merely indicate the fact that some sort of bodily reverberation is present.

The Problem of Criminal Mentality

One of the most important problems, and at the same time one of the most difficult in the field of criminal psychology, is the proper understanding of criminal mentality. The problem is important, not only to insure proper punishment, but to insure, wherever possible, the prevention of crime. Where criminal actions are the result of mental disease, the problem belongs to psychiatry and not to law, for an insane person cannot be held guilty of crime. Judges and juries have, however, to discriminate degrees of responsibility, and the psychologist interested in legal problems must be prepared to draw, for the court, a faithful picture of the normal human mind and of the conditions under which it may become perverted. Aside from disease, fatigue, depressing moods, drugs, and alcohol are some of the conditions which lead to criminal actions. As a matter of fact, however, a very large percentage of criminals are mentally inferior, and psychologists have had a serious problem in modifying or helping to eliminate the conditions under which the mentally inferior go wrong.

Legal and Scientific Conceptions of Crime.—There is a great difference between the current legal conception of crime and the psychological conception. "The current legal conception is based on the metaphysical theory of freedom of the will; the individual must exercise his will under the guidance of ethical principles; he is responsible for his acts unless, owing to immaturity or mental disease, he is incapable of distinguishing right from wrong and is thus bereft of proper guidance; when no such incapacity can be shown he must undergo punishment in proportion to the gravity of his crime: this punishment or retribution, which is nothing but a systematization of the original impulse of revenge, is now most frequently justified as a deterrent measure; by instilling a fear of similar punishment, it is supposed, society protects itself against repetitions of the crime; under the influence of this fear responsible persons—*i.e.*, those capable of distinguishing right from wrong—will refrain from doing wrong. . . .

"The scientific conception of responsibility is, of course, very different; the metaphysical theory of the freedom of the will has no place in science; the phenomena of the will, like other natural phenomena, are subject to natural laws and are determined by antecedents such as heredity, education, various environmental influences, and events immediately preceding a given act under consideration, that is to say, factors for the most part beyond the control of the individual; responsibility, therefore, in the sense of liability to profitless suffering in retribution for wrongdoing, does not exist scientifically in any case, sane or insane." [1]

Relationship between Mental Defects and Crime.—The relation between mental disorders and crime is striking. Goddard has found that the percentages of mental defectives (feeble-mindedness) as discovered by the Binet tests run, for various reformatories, as follows: [2]

TABLE VII

	Per Cent
Rahway Reformatory, New Jersey	46
Geneva, Illinois	89
Ohio Boys' School	70
Ohio Girls' School	70
Virginia (three reformatories)	79

"Whatever the final verdict of criminal anthropology may be concerning the physical peculiarities of the instinctive criminal, the evidence that a large proportion of crime is the outcome of innate mental defects and vicious propensities is abundant and convincing. Nearly all who have personally investigated the subject have found a high degree of criminality, alcoholism, and mental defect in the parents of criminals. Dr. Virgilio finds crime in 26.8 per cent of the parents of criminals, associated frequently with alcoholism. In the parentage of 447 criminals Penta found criminality in 88 cases, hysteria in 55, epilepsy in 33, alcoholism in 135, and insanity in 85. In the parents of 104 criminals whose heredity was examined by Lombroso there were 31 alcoholics, 10 criminals, 10 insane, while criminality and prostitution were prominent in the brothers and sisters. According to Ellis, ' of the inmates of the Elmira Reformatory 499, or 13.7 per cent, have been of insane or of epileptic heredity. Of 233 prisoners at Auburn, New York, 23.03 per cent were clearly of neurotic (insane, epileptic, etc.) origin, in reality many more.' Sichard, in 4,000 German criminals, found a neuropathic inheritance in 36.8 per cent." [1]

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[1] Rosanoff, A. J., *Manual of Psychiatry*, pp. 183ff.

[2] See Goddard, H. H., *Feeble-mindedness*, 1914.

Such statistics must not blind us to the fact that criminal behavior is also acquired. This is particularly true of sex crimes, many of which are due to conflicts (see p. 296) or repressions which have their origin in unfavorable social relations. The solution of the legal problems raised by bad heredity is to be found in the programs of eugenics and euthenics; a decrease in crimes due to conflict lies in a better understanding of original nature, and of the development of complexes and repressions.

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[1] Holmes, S. J., *The Trend of the Race*, 1921, p. 81.

CHAPTER XXI

PSYCHOLOGY AND MEDICINE

Introduction.—Primitive man dealt with his diseases and afflictions by using the principle of sympathetic magic. One of the commonest magical practices consisted of a series of incantations over a sick person after which some article or object that had touched his body would be taken away and burned or otherwise disposed of under the supposition that the disease or ailment would depart with the discarded object. Magic grew into religion and it is natural that in the subsequent history of disease, methods of healing should have been associated in a peculiar manner with religion. It is a curious fact that the religions which have made the greatest appeal to humanity have made bodily and mental health a large part of their program. The Christian religion has the most venerable history in this respect. More recently the doctrines of Christian Science and related systems of mental healing have enjoyed a tremendous expansion because of the hope they offer to the sick.

Religion and Healing.—It is not by chance that religion and health have been made almost synonymous. The religious consciousness and religious doctrines are frequently characterized by a forward-looking spirit. They are full of a certain type of optimism and cheer. A "healthy soul" falls into these attitudes easily, while a "sick soul" shuns them and finds no comfort in them. The relation between methods of cure and religion is still more specific, however, for whenever primitive man met objects in the universe that were too much for him he sought for escape by appealing to powers outside of his immediate experience (see p. 312). He did the same when he was sick or diseased; and it is natural that a cure for his body should be guaranteed in his religion just as are protection from storms, strength in the fight against evil, and a home after death.

The appeal to a divine healing power finds its highest expression in the Christian religion. One of the announced missions of Christ was to heal men's bodies. Christ's healing power was, professedly, of divine nature; but its success rested essentially upon certain attitudes of faith and belief on the part of the recipient, attitudes which have continued to produce beneficent results ever since his time. The healing power manifested by Christ was, on one occasion, given to his disciples; but it could be exercised only under precise psychological conditions. After the death of Christ all manner of diseases were healed, it is alleged, by prayer and by touching objects supposed to have been near the person of Christ. Throughout the Middle Ages cures were wrought by images of the Christ, of Mary and of the disciples, and by any object about which had grown a favorable tradition. As long as a majority of the people believed in the divine right of kings to rule by commission from God, the royal touch was the source of many cures. In our own day a large number of "dominating personalities" have turned from their doors hundreds of individuals who came sick and diseased but who departed healed and hopeful.

Disease as Demon-Possession.—When insanity and other mental perversions were thought to be the result of demon-possession, methods of cure were incredibly magical and foolish. The incantations of the most primitive people betray less superstition than is to be found in the exorcisms of a century or two ago. The following formulæ illustrate the crudity of beliefs prevailing at the time of some of our own immediate forefathers.

> "Thou lustful and stupid one, . . . thou lean sow, famine-stricken and most impure, . . . thou wrinkled beast, thou mangy beast, thou beast of all beasts the most beastly, . . . thou mad spirit, . . . thou bestial and foolish drunkard, . . . thou greedy wolf, . . . most abominable whisperer, . . . thou sooty spirit from Tartarus, . . . I cast thee down, . . .

Tartarean boor, into the infernal kitchen! . . . Loathsome cobbler, . . . dingy collier, . . . filthy sow, . . . perfidious boar, . . . envious crocodile, . . . malodorous drudge, . . . wounded basilisk, . . . rust-coloured asp, swollen toad, . . . entangled spider, . . . lousy swineherd, . . . lowest of the low, . . . cudgelled ass."

"By the Apocalypse of Jesus Christ, which God hath given to make known unto his servants those things which are shortly to be; and hath signified, sending his angel . . . I exorcise you, ye angels of untold perversity!

"By the seven golden candlesticks, . . . and by one like unto the Son of man, standing in the midst of the candlesticks; by his voice, as the voice of many waters; . . . by his word, 'I am living, who was dead; and behold, I live forever and ever; and I have the keys of death and of hell! I say unto you, Depart, O angels that show the way to eternal perdition."

"May Agyos strike thee as he did Egypt, with frogs; . . . may all the devils that are thy foes rush forth upon thee, and drag thee down to hell! . . . May . . . Tetragrammaton . . . drive thee forth and stone thee, as Israel did to Achan! . . . May the Holy One trample on thee and hang thee up in an infernal fork, as was done to the five kings of the Amorites! . . . May God set a nail in your skull, and pound it in with a hammer, as Jael did unto Sisera! . . . May . . . Sother . . . break thy head and cut off thy hands, as was done to the cursed Dragon! . . . May God hang thee in a hellish yoke, as seven men were hanged by the sons of Saul!" [1]

Healing by the King's touch began, possibly, in the eleventh century under Edward the Confessor and the ability was passed on from reign to reign through Henry VIII, Elizabeth, and Charles II with increasing miraculous efficacy. Charles II is supposed to have touched at least a hundred thousand persons and a great many of his "cures" have been put down in the literature, a certain Sergeant-Surgeon Wiseman saying that "I myself have been frequent witness to many hundreds of cures performed by his Majesty's touch alone without any assistance of chirurgery, and these many of them had tyred out the endeavours of able chirurgeons before they came thither."

[1] White, A. D., *A History of the Warfare of Science with Theology*, 1883, Vol. 2, pp. 107ff.

Christian Science.—Christian Science, in so far as it is a scheme of mental healing, comes from similar antecedents. In the early years of the last century a Frenchman by the name of Poyen came to New England from France where he had been closely connected with "researches" in animal magnetism as a curative power. Among his auditors in New England was a Dr. P. P. Quimby who manifested great interest in the new doctrine and who was able, within a few years, to build up a large practice. The essential features of Quimby's methods consisted of the use of hypnosis, the passing of hands, and practices of a similar nature. Among his patients was a neurotic individual by the name of Mrs. Eddy, who had possibly heard Poyen himself, but who in any case, became intensely interested in the new movement. In 1866 it is alleged that Mrs. Eddy was healed by the ministrations of Dr. Quimby, and with this proof of the efficacy of the doctrines Mrs. Eddy began her own studies in the new field. She came shortly to the conclusion that the success of the new system could not lie in the material substance of animal magnetism nor in such manipulations as the passing of hands. On the contrary she concluded that healing must depend entirely upon mental or spiritual factors. She then proceeded to elaborate this doctrine, coupling it with certain aspects of the Christian religion, and shortly founded the whole scheme upon a curious metaphysical conception of the ultimate spiritual nature of the universe. Her reflections appeared in 1875 in the first issue of *Science and Health*. The relation of her doctrine to health was of such a character as to make a tremendous appeal to the imagination of people and her system has spread with great rapidity, leaving, in its wake, without doubt, a large number of remarkable cures.

Other doctrines, such as the Emmanuel movement of Boston, came from Eddyism; and, in addition, almost every section of the country boasts of at least one personality before whom diseases seem to disappear and about whom an invincible tradition of power and efficacy has been builded. It is folly, therefore, to deny the fact that healing on a very large scale has been accomplished by psychological means. The gospels are full of such accounts, and records of the same nature have been accumulating ever since. Our attitude is not one of skepticism and neither is our study to be construed as a direct attack upon any religious system. We are concerned only in describing and explaining, where explanations are forthcoming, the facts as they appear.

Methods of Psychological Healing

The reader must recall what was said in Chapter XIII concerning the different types of bodily ailment if he is to understand the successes and failures of psychological methods of healing. Four types of ailment were described, viz., traumatic injuries, toxic disorders and diseases, nervous diseases, and functional diseases.

The relation of psychological methods of cure to the first three kinds of bodily affliction is easily established. It is now generally conceded by scientific men that direct cures of traumatic injuries, toxic diseases, or of genuine nervous diseases do not and probably cannot be brought about through psychological means. There is no doubt, however, that cures of this kind may be distinctly promoted, at second hand, as we shall presently show. The functional diseases do yield, however, and rather readily, to the psychological methods of treatment. Six such methods have been proposed at one time and another and all of them have been found useful in treating one or more varieties of ailment. These methods are (*a*) the method of hypnosis, (*b*) the method of psychoanalysis, (*c*) the method of suggestion, (*d*) the method of autosuggestion, (*e*) the method of reëducation, and (*f*) the methods of rest and relaxation.[1]

Hypnosis.—We have already had occasion to describe the nature of the state of hypnosis and the relation which it bears to normal mental life. Its use as a diagnostic and curative agent in disorders of mental life runs back for several decades. Under the state of hypnosis an individual responds freely to the suggestions that are given to him, and as we have just seen, Freud was able by this means to tap many of the forgotten experiences that lay, as he believed, at the basis of the various mental ailments. In general practice, the suggestible state of mind of a hypnotized patient makes it possible for an operator to relieve pain, secure sleep, inhibit the formation of topical associations, augment the reëstablishment of old associations, and set going a variety of other therapeutic agencies.

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[1] Read Janet, P., *Psychological Healing* (tr. Paul), 1925.

The greatest value of hypnotism, however, lies in what is called posthypnotic suggestion. That is to say, it is possible to instruct an individual during the hypnotic trance, that "the fixed idea is to disappear forever, the paralyzed limb is under control, the desire for morphine and cocaine is gone for all future time, the perverse longing is annihilated," and to find that, during the posthypnotic period the instruction tends to become operative. Under repetition it has been possible to build up so intense an instruction against mental disturbance or unsocial desires that genuine cures are often wrought. A typical example runs as follows: S—— was a young lady admitted to the hospital suffering from an extreme case of hysteria. Under her attacks she became violently emotional and criminal. Her habits had become filthy and she was unable to take care of her own person or of her room. At the beginning of her treatment the hypnotic suggestion was made that she should sweep her room at a designated time. After repeated suggestions the instruction was finally carried out. Other habits of cleanliness were gradually established, the disturbing source of her hysterical attacks removed, and she was finally discharged from the hospital, a normal person. A year later she had completed a successful term of work as a cook and maid.

Psychoanalysis.—The second method of mental healing is the psychoanalytic method. This method has come directly from Freud and implies a Freudian theory of the nature of mental disease. It had its origin in the fact that some of Freud's patients could not be hypnotized. One day, as he was observing the operations of another physician, he saw that, by leading a patient on with suggestions, the patient could be made to recall all that happened during an hypnotic sleep. Unless some such means are taken to aid recall, a hypnotized subject does not remember what has happened during the period of induced sleep. It occurred to Freud that if such a method were possible in aiding the recall of events taking place during hypnosis it ought to be available in general practice. He took one of his patients and after gaining his confidence began to question him regarding his early life. Gradually he set the individual to talking and then to giving mere word associations and found that he could, finally, reconstruct out of the associations that had been given, a connected account of an early experience which seemed to be causing the symptoms complained of. In this manner Freud turned to practical service the facts of serial or successive associations. As his method developed he gave to his patients key-words from which they were to take their start. He found, as successive associative bonds were established, that certain significant words were repeated or that associative tendencies always culminated at about the same point.

The psychoanalytic method consists, then, of diagnosing the memories of an individual by using successive associates. Once the hidden source of trouble is found the physician can take steps to sublimate it or to allow it to merge with the whole field of consciousness and when this is done the symptoms of mental perversion disappear.

Uncovering the Complex.—In order to use the method successfully a certain amount of preparation of the patient is necessary. The double effort is made with him, to stimulate his recollection of his past experiences and to eliminate the critical attitude which he is ordinarily in the habit of assuming toward the memories which he allows himself to enjoy. For the purpose of self-observation with concentrated attention, it is advantageous that the patient occupy a restful position and close his eyes; he must be explicitly commanded to resign himself to any recollections which may appear. He must be told further that the success of the psychoanalysis depends upon his noticing and telling everything that comes into remembrance, and that he must not allow himself to suppress one idea because it seems to him unimportant or irrelevant to the subject, or another because it seems nonsensical. He must maintain impartiality toward his memories, for it would be owing to just this critical attitude if he were unsuccessful in finding the desired solution of the dream, the obsession, the hysterical attack, and the like.

Having gained the confidence of the patient and having got him into a favorable attitude the psychoanalyst then calls for successive associations. When the patient hesitates or seems loath to let the associative pattern run on the physician notes the fact and seeks to approach the complex through some other associative train. Sooner or later the patient will be forced back to the complex, and having once recognized it for what it is, the symptoms of mental perversion disappear.

Analysis of Dreams.—The method of successive associations is materially aided by the analysis of dreams, of slips of the tongue, and of other symbolical expressions of repressed desires. Some dreams are undisguised wishes and desires. The child who dreams of a mountain of candy or the adult who dreams of success in the morrow's business is indulging in his sleep in a wish that is not hindered by the objects of the waking hours. But more often the dream is symbolical. This is especially true of wishes and desires that come from the subconscious and which relate to socially forbidden or disapproved activities. In symbolical dreams the psychoanalyst acts as an interpreter. To aid the process of interpretation the followers of Freud have discovered, according to their own assertions, standard symbols. Most of these make it possible for the individual to play freely in his dream life with sexual problems without arousing the suspicion of the censor. "We should then assume in each human being, as the primary cause of dream formation, two psychic forces (streams, systems), of which one constitutes the wish expressed by the dream, while the other acts as a censor upon this dream wish, and by means of this censoring forces a distortion of its expression."[1] The dream is, accordingly, if we follow Freud's explanation, the disguised fulfillment of a wish that has been suppressed during the waking life.

Dreams which are the expression of a repressed wish often appear clothed in symbols. The psychoanalyst makes use, therefore, not only of the dream itself, but of the symbols that have appeared in the dream. It is impossible to give a list of these symbols, for almost any object may be used as a symbol of some other. The function of the symbol, however, is to allow the dream to refer to objects and acts which would not ordinarily be referred to or thought about if the patient were forced to use relevant language. The interpretation of these symbols, then, is limited only by the ingenuity of the interpreter, *i.e.*, the psychoanalyst.

The Antiquity of Psychoanalysis.—A trouble or a disappointment told to a friend is not half the trouble or disappointment that it is if kept chained within us. The confession of son or daughter to mother and father, the confession of sinner to priest, the intimacies of friends, exchanges of confidences, are all ways of uprooting or ameliorating experiences which might otherwise vex and trouble us and produce, in the long run, pathological uneasiness.

Psychoanalysis, then, is as old as human fellowship. It is as old as confession one to another. What is new in Freudian psychoanalysis is the assertion that sex experiences are preponderant among the troublesome and discordant notes of life. But not all psychologists are persuaded that the sex element is so prevalent as the Freudian theory supposes.

Suggestion.—The method of suggestion is the oldest of the methods we have to describe and one of the most valuable when it is cleverly used. There is no doubt that most, if not all, of the mental cures described in the gospels and in the medical literature since that time rest more or less directly upon suggestion. The term itself is hard to define, as we have already discovered, but it implies on the part of the patient a state of mind that makes implicit his acceptance of, or his belief in, a command or a statement. That is to say, suggestion implies that an individual is prepared to accept without criticism or comment or objection the statement or the belief of another. Occasionally an object,—a crucifix, a handkerchief, an altar, any relic,—may be substituted for the command of another person.

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[1] Quoted from Freud by Rosanoff, A. J., *Manual of Psychiatry*, p. 108.

The efficacy of suggestion as a means to mental health has assured medical science that much mental perversion consists of convictions that have gone wrong, or associative patterns that carry more than their share of significance. Many mental disturbances owe their origin to moody or associative patterns that get started during fatigue and continue their courses with an intensity out of all proportion to their significance to the whole of mental life. It is obvious that if a patient has been made ill by a suggestion, he ought to be curable by a counter suggestion. It is equally obvious that if suggestion has produced any degree of dissociation a contrary suggestion might produce the original degree of integration.

In a large number of cases knowledge of the mental facts and laws concerned is sufficient to keep individuals upon a consistent mental level. If they do not have the necessary information a heart-to-heart talk with a physician often serves to show the origin of adverse mental symptoms and the means that must be adopted to remove them. Argument with a patient suffering from paranoia would, of course, be futile, but with lesser mental malfunctionings knowledge of the conditions is a good source of mental health. In these relations it is necessary that the physician proceed tactfully and throw over to the patient himself the responsibility for the cure. The use of persuasion or of a formal assurance or direct command that sleep will come or motor restlessness disappear often brings desirable results. Changing the environment to aid the effect of suggestion has often been resorted to. Medicines of colored and flavored water, applications of electric instruments without currents, sham operations, pleasant or quieting surroundings, optimistic associations, materially favor the efforts of a physician to leave by indirect comment an assurance of coming health or the returning use of a limb. Any means that contribute directly or indirectly to the building up in the minds of patients a feeling of assurance that a cure is on the way or that their health is a matter of their own desire for health aids materially in securing the hoped-for ends.

"Shell Shock."—The afflictions grouped under the phrases "war psychoses" or "shell shock" bear out the supposition that ideas may, under fatigue or extreme emotion, become dissociated from experience. Functional blindness, for example, means that an individual has come to a hospital without bodily damage or any of the evidences of central disturbance save his blindness. Under treatment it turns out that such an individual is literally in the state of one who is blind because he *believes* he is. The physiological mechanisms underlying this sort of functional ailment are not known; but fortunately the treatment of such cases does not have to wait for an explanation.

When a high explosive shell falls near a man, he is apt to be so apprehensive about his own person that he pays no attention to external stimuli. His is an exaggerated case of the individual who is so interested in an occupation that he does not feel a light touch upon his shoulder or the discomfort caused by a high or low temperature in the room in which he is working. To all intents and purposes he is functionally blind, deaf, and anæsthetic; but a shift in attention is all that is necessary to "cure" such an individual. The soldier near the high explosive shell, however, is in a different situation. As he regains consciousness his first fears are toward his own well-being. Visual, auditory, and cutaneous sensibility and motor ability may gradually return; but if anything is in the least wrong he falls easy prey to the belief that he has lost sight, hearing, or some other capacity. In simple terms the "cure" consists in making him attend again to the experiences he misses. Cures of this kind and of many related kinds can be illustrated by the following case:

"Case 1.—Total blindness with loss of pupil reflexes following shell-concussion: hysterical nature proved by rapid cure by psychotherapy after persisting for four years.—Pioneer B., aged 41, went to France in September, 1914. After six weeks' fighting he was stunned as the result of the explosion of a shell in his immediate vicinity. In the evening he noticed he could not see clearly, and attributed this to the shock of the explosion. He at once feared he would lose his sight: his eyelids began to droop, and he had difficulty in focusing near objects. He was sent to England, where the use of eye-drops and dark glasses confirmed his fears, and in a short time he became totally blind. Early in 1915 he was discharged as permanently unfit, receiving a full pension for total blindness. He was examined every six months after this, but no treatment was given. In November, 1918, he was seen by Mr. J. R. Rolston, of Plymouth, who recognized the condition as hysterical, and advised his transfer to Seale Hayne Hospital, where he was admitted on November 13, 1918. He presented the picture of the typical blind beggar of the street. Unshaven, unkempt, and dirty, and wearing a pair of dark glasses, he came supported by his wife, while in his hand he carried a thick stick to help to guide himself. Whilst wearing the glasses he kept his eyes open, but could see nothing; when they were removed he was unable to raise the lids owing to severe blepharospasm, except in a darkened room.

"Treatment was commenced the same evening, and in a short time the blepharospasm was overcome, and the patient opened his eyes, but he was still totally blind. The pupils were then found to be widely dilated, with no trace of reaction to light. The flinch reflex was completely absent in both eyes. Ophthalmoscopic examination showed nothing abnormal, and a definite diagnosis of hysterical blindness was made. Explanation as to the nature of his condition and encouragement to use his eyes rapidly led to partial restoration of vision, but at the end of two hours he still stumbled over objects placed in his path. After a rest of an hour, treatment was continued and further slight improvement occurred. In attempting to focus his eyes he made strong contractions of the muscles of the neck, similar to those seen in the spastic variety of hysterical aphonia when the patient attempts to speak.

"The next morning he was taken out of doors, and distant objects were soon recognised. An endeavour was then made to teach him to focus his eyes on nearer objects, and by evening he could read 6/24 at 20 feet. The excessive contractions of the neck muscles continued, however, but by encouraging him to relax they gradually disappeared, and vision steadily improved. He was still inclined to stumble over objects placed in his path, but this was merely due to inattention. On November 25 he could read with each eye in turn 6/12 at 20 feet, and he could spell words printed in small type, but as he was almost completely illiterate he could not pronounce them. The flinch reflex and the normal pupillary reactions to light had returned the first evening.

"The patient was also completely deaf in the left ear on admission; he was given instruction in listening, and at the end of a week he could hear normally. When seen four months later, in February, 1919, he was at work as a watchmaker and gramophone repairer." [1]

Autosuggestion.—Enough has now been said of the nature of mental disease and of the methods of cure to show the uses and limitations of autosuggestion. The process is not mysterious and neither is there to be got from it any direct cures of organic ailments. The use of the method and the limits of its value may be illustrated in this manner. If it were impossible for a member of an audience who has been absorbed in Mendelssohn's "On Wings of Song" to change the direction of his attention—to swing over to another group of ideas—we should say that he was mentally perverted. But a normal person does not stay wrapped up in the affective contemplation of a piece of music. Attention shifts and the enjoyment of the experience takes its normal place among other experiences. During the actual moment of enjoyment there may be little else in experience. Consciousness is a "song consciousness." There is no sign that presently one is going to think about something else. The something else no more exists for us than the feeling of magnetic attraction. In other words, it is a characteristic of mental life not only that attention should shift from one object to another, but that it should hang on to one experience to the exclusion of others. If, now, we hang to the belief that we cannot see, a cure lies in shifting our attention to experiences which prove that we can see. Suggestion is one means of getting attention to shift; autosuggestion is another means; but they both work in the same way.

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[1] Hurst, A. F., *The Psychology of the Special Senses and their Functional Disorders*, 1920, pp. 95–97.

The catch-phrase "Day by day in every way, I am getting better and better" is a convenient verbal habit which keeps one constantly thinking of better things. There is no secret power in the formula; but it does set off a determining tendency which makes the individual attend to good food, good water, good exercise, good books, good lectures, good conversations, and good thoughts. Like prayer it sets an individual into an attitude that favors attention to the things that actually will make a person better.

Reëducation.—The method of reëducation is one that was used to great advantage during the war. It is more of a psychophysiological method than a mental method, for it involves, frequently, the reëstablishment of motor functions as well as a systematic mental reorganization. One of the greatest problems has been the reëducation of blinded individuals. Vision plays so large a part in all of the intellectual accomplishments that its sudden loss means a large reorganization in mental life. The method of reëducation as applied in this case involves training the other sense-departments and particularly the cutaneous senses to take the place of vision. The results of the process have been wonderfully successful. The method has been applied, also, in getting partially paralyzed arms and legs to operate again as they did before an accident or a gunshot wound. One variation calls for daily practice in the voluntary movement of the muscles concerned and another calls for the manipulation by an attendant of various members of the body. Some of the mental diseases are also amenable to the method, especially where functional disorders are so deeply seated as to resist suggestion or even hypnosis.

The Rest Cure.—The final method, the rest cure, describes itself. It implies, of course, far more than a good period of sleep. There seems to be a certain therapeutic value in change of scene and change of activities. The rest cure can be applied readily to all of the "fatigue psychoses" and to many of the more deeply-rooted functional disorders.

Sleep is a great restorative agent. During the night the body is able to get ahead in replacing worn-out tissues and collecting refuse in the organs of excretion. There are a number of theories of the cause of sleep, one of them saying that the manufacture in the body of toxic or fatigue products affects the resistance of the synapses. An increase of synaptic resistance would, it is said, cause partial unconsciousness. As these toxic substances are removed the resistance is brought back to its normal level and the refreshed body is able to go ahead with the new day's work.

Rest may, however, be equally efficient during the waking period. The body responds not only to specific stimuli but to stimulus patterns or situations. But situations may become monotonous and they are often conditioned by adverse moody sets. Objects pall us; we become stale or restless. In these cases a change in the total situation may furnish the rest that is needed. To be excited by new objects and to forget, for a moment, the old, is often better than drugs.

Mental Health.—As long as mental life was identified with the soul the problem of mental health was meaningless, meaningless, that is, to any one doubtful of demons; but it is now seen that mental life and behavior, like our bodies, must be subject to a health regimen. In a certain sense behavior patterns are *erected,* the stream of experience is broadened. The infant begins to collect mental material for the total structure even before birth and throughout its earlier years it is engaged primarily in the task of collecting additional material. As collection goes on the behavior edifice is constructed. It takes shape under the direction of hereditary patterns in the nervous system and under the direction of its social and physical environment. The total structure—the self—gets its final form in adulthood. A well-built edifice is balanced and every part of it is contributing to the soundness of the whole building. But architects make mistakes. There are often structural weaknesses in the lower levels of the building. Sometimes one part of the building is enlarged beyond the limit of good proportions.

Mistakes of the same kind are made in the erection of behavior patterns. Freud has performed the service of showing that basal experiences in the whole edifice *must* play their proper part, that the foundation *counts.* It is not profitable to leave some of them hanging in mid-air, so to speak, under the supposition that they have no part to play in the erection of a self. Like an ancient castle that holds prisoners who are always seeking to escape from damp dungeons, poorly erected selves are said to keep unsocial or unpleasant experiences. It is pure speculation to suppose that forgotten experiences retain a certain amount of energy and seek, therefore, to get back into the stream of consciousness; but it may very well be that neuronal chains or determining tendencies have a certain amount of energy which makes it possible for them to bring into today's mental life the experiences which they conditioned at some previous time. It is even possible that determining tendencies and associative patterns may incubate over a long period of years gathering energy from other neuronal systems and conditioning, finally, a state of consciousness merely symbolic of the state originally conditioned.

In the erection of a personality the mistake is often made of building towers, that is, isolated reaction systems, between which there are no connecting hallways, no integrating patterns and systems. A solid, well-planned building doesn't come out of a half-dozen pinnacles. There are a number of conditions under which mental life and behavior is made one-sided. It frequently happens that a group of determining tendencies develop more energy than properly belongs to them and come shortly to prevail over other tendencies and patterns. No provision has been made for the integration of one behavior pattern with another. There are no corridors leading from one suite to another. This, apparently, is what happens in any form of mental disintegration.

Speculations and analogies of the kind we are using are scarcely justifiable save as they emphasize the fundamental importance of mental organization. A high degree of mental organization means mental health. It means that an individual is not subject to detached trouble-making experiences, that groups of ideas do not determine his whole conduct or set themselves in conflict with other groups. Mental organization—personality—means that all of the experiences of an individual have entered into a single unified structure.

There are several means of insuring good mental organization and so guaranteeing mental health. The first of these is knowledge. It is one of the virtues of Freud to have shown that acquaintance with the experiences which ignorance has suppressed brings about a complete cure. Knowledge is power anywhere. Books, schools, conversations, arguments, museums, lectures, in fact, all sources of knowledge are constant sources of excitation to the nervous system. Facts keep stirring up old facts; associative tendencies that are being constantly exercised do not get covered up and dissociated from the rest of the nervous system. Reading and the cultivation of the arts prevent the formation of isolated or repressed experiences. One-sided mental organization is always apt to lead to mental trouble. There is nothing that has to be forgotten. Knowledge makes it possible to prevent things from happening that are so unexpected and shocking as to topple over a self that is in the process of erection.

Self-control and will power are phrases which seem to be applied to individuals who have *persistent* and *insistent* habits and ways of thinking. The habits are persistent in that they are not overcome by chance experiences of the day. The habits are insistent in that they tend to insinuate themselves into all that the person does. The development of will power and self-control is, then, the task of developing persistent and insistent habits. Healthy minds avoid extremes. Knowledge is a way of avoiding extremes. New, sudden, unexpected, highly emotional experiences are very apt to carry one to an extreme. Worries come from experiences that have not been made to take their proper place among the rest of one's experiences.

One of the chief means to mental health is an abundance of play. Play means bodily health and bodily health means a healthy nervous system. There is no time of the day or week when the healthy mind ought not to be able to shift attention from the "shop" to incidental but race-old activities which can be engaged in for their own sake.

In the final analysis mental health can only be gained by breeding out of society the hereditary factors which issue in mental perversions. Knowledge of the body and of the influence of drugs upon it keeps the sound person from excesses in this direction; but hereditary mental defects have to be cut out by the roots.

Conclusion.—There is no doubt that a large number of diseases can be and actually are cured by mental means. Most of the cures wrought by religions, by personalities, or by sanctuaries depend upon the suggestions offered in the religion, by the healer, or symbolized in the sanctuary and its relics. The diseases so cured are very obviously of the functional type. What shall we say, however, of the alleged cures of traumatic, toxic, and nervous disorders? We must insist that no direct cures of this kind have ever been proved, but it is entirely possible that these ailments may be affected indirectly by psychological means. Body and nervous system stand so close together in all of their operations that it would be strange if influences acting upon the one did not operate to some extent upon the other. In general functional disturbances, for example, the organic conditions of the body are indirectly affected. The digestive, respiratory, and cardiac functions may be seriously impaired and under these conditions the body becomes readily accessible to bacteria or to toxic products which may run their damaging course in it. Now it is altogether possible that a removal of the psychological disturbances may so change the organic set of the body that, by its own operations, it could soon overcome the source of organic disease.

As a matter of fact, almost all medical practice rests upon the assumption that the mental condition of a patient has much to do with the course of convalescence. Every effort is made in a modern hospital to induce and maintain in patients a high degree of optimism and cheer. What the relations are between the affective processes and general organic set have not yet been established. It has been alleged that pleasantness is an index of favorable organic conditions and unpleasantness of unfavorable conditions. It will be recalled that the expressive methods rest upon some such assumption. There seems to be no doubt that a general relation must obtain and it is legitimate, in dealing with bodily diseases, to take advantage of this relation wherever possible.

In the sick room or at the hospital it is not an ideal, typical doctor who meets an average patient but one individual who is meeting another individual. The doctor or the surgeon is a man possessing certain personal characteristics that distinguish him from other medical men, and the patient, likewise, possesses a personality that is peculiarly his own. Out of the meeting of these two individuals must come a livelihood for the one and health for the other. The meeting, however, is not like the ordinary social contacts of the office or of the street or of the club. The patient is suffering pain or discomfort; he is, perhaps, gloomy or even despondent; he may be distrustful of the man who has to pit his drugs or his knife against disease. Under these difficult conditions one man meets another and the success of their meeting may often depend upon the psychological conditions obtaining at the time.

Much has been written and more said of the psychology which the physician and the surgeon may use in dealing with their patients. We read of the necessity of gaining the confidence of the patient, of concealing from him the serious aspects of his case, of surrounding him with all kinds of suggestions implying an early recovery or a modicum of pain, of attempts to keep patients cheerfully disposed, and the like. Most of this sort of psychologizing arose during the days when the family physician took care of the health of a small neighborhood. He knew beforehand the families to which he would be called, he had followed many of the members from infancy to adulthood, and his differential psychology was largely a product of his neighborly acquaintances. Much of modern medical work, however, is done by specialists, or at least by men who are not intimately acquainted with the patient's family, and the need, therefore, of some sound principles of differential psychology has become much greater. It is, of course, impossible for a physician or a patient to know beforehand the peculiarities of the man with whom he is about to deal; but it is possible to recognize the fact that individuals do vary from one another and to take appropriate steps to discover and adjust oneself to the outstanding differences. That is to say, aside from the counsels of common sense and of social intercourse, the physician should have a sound training in the science which has to do with minds. From such knowledge may come the counsel and the examples that will force traumatic and toxic ailments to profit under favorable mental conditions.

CHAPTER XXII

PSYCHOLOGY AND COMMERCE

Introduction.—In a previous chapter we have seen how the relations between psychology and education developed naturally under the needs which educators themselves were free to express. The child was a growing human being and it took no great amount of insight to conclude that successful education must, in the last analysis, depend upon sound psychological principles. In other fields, however, the value of psychology has not been so apparent. In the various phases of commerce, for example, the contributions which psychology might make had to wait upon a recognition of the fact that the human element must enter very largely into barter and exchange and even into the production of goods. So long as industries were thought of as great machines and men as cogs in the whole device, little could be done by psychology to improve the "cogs" or administer to the psychological aspects of production. The twentieth century, however, has brought a great change in the philosophy upon which industry and commerce stand. The phrase " human engineering " has begun to take its place among other forms of engineering; men are now recognizing that human beings are not mere manipulators of mechanical devices but that they are personalities, intelligently behaving creatures contributing in a very vital way to the efficiency of commerce, business, and industry in their many phases. With the recognition of the human element in business and in industry the facts of psychology and their relation to these forms of human activity became pertinent, and the last decade has witnessed a veritable revolution in the attitude of industrial and commercial establishments toward the facts of psychology.

Psychology of Advertising and Salesmanship

One of the first problems from the world of business to yield to experimental methods was the problem of advertising. This problem came into the experimental laboratory early in the history of applied psychology and there is probably more experimental material now on hand here than in any other branch of technology save education. Advertising has been an economic and psychological problem ever since man ceased to be able to live on his own products and found that it was advantageous to trade his goods with other individuals. Although it was not until after the invention of the steam engine and other labor-saving devices that a local oversupply of goods made advertising a serious economic problem, it has been a psychological problem from the time the first primitive man began to barter or exchange his possessions until the present moment.

The modern problems of advertising spring from a twofold relationship between man and industry. Man has needs to be satisfied and desires and interests to be catered to. Industry, on the other hand, has goods which will satisfy these needs and interests. It has, moreover, goods for which it must create an interest if not a need. The economic welfare of society depends (*a*) upon building up as wide a demand for goods as possible, and (*b*) upon providing for as many of man's needs and desires as it can. That is to say, industry *must* get its goods before the public and sell them. Out of this dual relationship the problems of advertising arise.

Historical Notes.—The antecedents of current modes of advertising are of many sorts. The Greeks and Romans had public announcers who were accompanied by musicians, and who went about with great ceremony announcing the will of their rulers. Parchments, also, were posted in various places announcing divers events. Announcement was made of a gladiatorial combat in Rome promising fights with wild animals and an awning to keep off the sun, in the following words:[1]

AEDILIS. FAMILIA. GLADIATORIA. PUGNABIT.
POMPEIT. PR. K. JUNIAS. VENATIO ET VELA
ERUNT

Baths with warm sea and fresh water were advertised thus:

THERMAE
M. CRASSI FRUGII
AQUA. MARINA. ET. BALN.
AQUA. DULCI. JANUARIUS. L.

Excavations at Pompeii reveal numerous walls and " signboards" upon which were placed legends and drawings, some of them in color, but all for purposes of advertisement. During the early sixteenth century and thereafter the town crier came to fulfill, more completely, the office of a public advertising agent. At first he was a mere announcer but later his functions increased and finally it became quite customary for individuals to hawk their wares from street corners and other places of advantage. The discovery of the art of printing put the town crier out of fashion and, although it was many years after the publication of weekly and daily papers began before space was taken for advertising, notices and announcements gradually began to creep in until, at the present time, a large part of almost every paper and magazine is given over to classified and indexed advertisements.

The Experimental Study of Advertising.—Modern experimental interest in the problem of advertising was begun by Gale in 1900 with the publication of a series of brief experimental articles on the "legibility, attention value and the interest" of printed advertisements. In 1903 Walter D. Scott added materially to the matter by publishing a book on the general principles of the relation of psychology to advertising, describing principally the use of the laws of memory, association, feeling, choice, and the like. He used freely the questionnaire method but he went to the experimental laboratory as well and, in 1908, he published the results of his investigations in a book on *The Psychology of Advertising*, which is now familiar to students of Psychotechnology. From then until now experimental work on all phases of the subject has been growing rapidly in amount and value.

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[1] Sampson, H., *A History of Advertising*, 1874, pp. 37–38.

The objection was made, for a time, that the laboratory is not the place to settle questions in advertising, for among the conditions which affect the success of a given advertisement are size, position on the page, type of appeal (to reason, to sentiment, to the emotions, etc.), kind of type in printing matter, the medium (newspaper, magazine, signboard, window display, etc.), time of year, adjacent advertisements, financial condition of the country, activity of competing firms, number of subscribers to the advertising medium, and the like. Many of these conditions cannot be controlled; but the laboratory does offer the possibility of isolating a large number of the factors or at least of reducing the complexity of the problem, and it is now generally agreed that an answer to many advertising problems may be sought in the psychological laboratory. These studies are easily supplemented by statistical studies drawn from the commercial world itself.

Early Types of Experiment.—One of the earliest experiments consisted in asking a half-hundred or more subjects to look over, within ten minutes, a book made up of one hundred pages of advertising material. At the end of the period they were asked to write down such advertisements as they remembered. It was discovered that every full-page advertisement was mentioned on an average of six and one-half times; every half-page less than three times; every quarter-page about once; and the still smaller advertisements only one-seventh of the time. In other words, the experiment seemed to suggest that the memory value of the quarter-page was much smaller than one-quarter of the value of the whole page, and the memory value of the eighth-page much smaller than one-half the value of the quarter-page. That is to say, the advertiser who paid for one-eighth of a page received, not the eighth part, but hardly the twentieth part of the "mental value" of a full-page. In further experiments of this sort the books were prepared so that full-page advertisements occurred only once, half-page advertisements twice, quarter-page advertisements four times, and so on up to one-twelfth page advertisements repeated twelve times. Each page was observed twenty seconds and it was found that, in recall, the fourth-page advertisement repeated four times had one and a half times as much value as one repetition of a full-page or two repetitions of a half-page.

These early experiments have not proved wholly reliable because a large number of important conditions were not controlled; but they did indicate the general nature of the psychological problem and they prevised the sort of information one might expect in this particular branch of technology. They illustrated, moreover, a method which has become common in the experimental study of this problem. A large share of the experiments starts with a dummy made up either of advertisements selected from current journals, or of conventional diagrams, words, numbers, or nonsense syllables. The questionnaire method has been used in a number of studies, especially in discovering how permanently current trade-marks, symbols, and firm-names are impressed upon the minds of the public. Wherever practicable the actual inquiries in response to an advertisement are collected and statistically treated. As we have said, however, the best methods make use of the experimental laboratory and the control of conditions which it affords.

As a matter of fact, so many conditions have to be controlled that it is hardly possible as yet to put the experimental data together in a convenient summary. The preference value of colors, for example, varies with the sexes, the background, the time of exposure, the character of the illustrations using them, and the order of presentation. Studies are now available for almost all of these conditions; but the results are, as one might expect, variable. In using the dummy book, the results vary according to right- and left-hand pages, the time of exposure of each page, the position in which the book is held, the direction in which the leaves are turned, the size of the book, and the character of the binding. There is, moreover, difficulty in using published advertisements, for it is impossible to measure the variable influences which these advertisements may already have exercised over the subjects.

Psychological Problems in Advertising.—Upon a page of paper or its equivalent, business houses and firms, publishers, and retailers strive to set down, by argument, by illustration, or by appeal to interests and emotions, an announcement of goods. This announcement is to be seen or heard, it is to attract attention, it is to be remembered, it is to excite immediate or at least ultimate action in the form of an actual purchase. We see already the psychological problems in advertising. They relate to effective conditions of perception and attention, to effective ways of repeating an advertisement until it has a high memory value, to devices for inciting action on the part of the prospective customer before some other appeal has become effective. The problems which are now commonly put under experimental scrutiny for the sake of advertising involve all of the intellectual talents of a human being and a large number of environmental conditions affecting their operation.

It would be convenient if we could arrange the problems of advertising with respect to the various forms in which intellectual talent appears. We should then have to consider problems of perception, problems of attention, problems of learning and of memory, appeal to reason rather than to interest and emotion, and so on. The truth of the matter is, however, that the advertiser is not writing to a person's attention or to his memory. He is writing to a *person*, not to separate talents, and this makes it more useful to consider types of investigation, distinct advertising problems, rather than to attempt to force psychological classifications upon the field.

This book is not the place for a résumé of all that is known in the field. Here, as elsewhere, we mean to illustrate points of view, methods of research, and we state only as many typical problems and results as are necessary to carry out this program.[1]

The Position of an Advertisement.—A very large number of the experimental studies in advertising have been directed toward the selection of preferable pages and preferable parts of the page, as the following examples will show.[2] The respective value of each unit of a page divided into fifteen units is illustrated by the following tables containing the number of times each unit was first seen by 149 subjects as the pages were turned over from right to left. The numbers stand in the several positions of the fifteen page units.

TABLE VIII

471	10	16
30	23	2
44	28	1
24	15	0
19	1	2

Obviously, the upper left-hand corner of such a page is highly preferable, since it was chosen 471 times. The upper half of the whole page is considerably more effective than the lower half, and the left side is better than the right side. When the page is divided into eight equal parts the most effective area still lies in the same corner as before, as the following numbers show:

TABLE IX

277	21
13	5
3	4
4	0

With a page divided into four equal parts the following figures hold:

TABLE X

460	22
73	11

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[1] Consult Starch, D., *Principles of Advertising*, 1923.

[2] See Adams, *op. cit.*, Chap. viii.

When the page is divided in half horizontally the upper half is preferable, for the upper half was first seen 693 times and the lower half 117 times. When the attention value of right and left pages is measured the right page is found to be more effective. The upper half of either page, however, is twice as effective as the lower halves.

Studies on the position of an advertisement include also a search for the optimal position within a whole magazine or book. In one such test 137 subjects were assigned the task of reading an article in a popular magazine. A week later each person was handed an envelope containing all of the full-page advertisements which had appeared in the magazine together with many of the smaller ones, and they were asked to select those which they remembered as having appeared in the magazine. Of the 137 subjects tested, 49 per cent could not recognize a single advertisement afterward, 24 per cent could recognize from 1 to 10 advertisements each, and 30 per cent could recognize 11 to 50 advertisements each. Of the 24 per cent, 16 per cent could recognize from 1 to 5 each, 8 per cent could recognize from 6 to 10 each, and of the 30 per cent, 15 per cent could recognize from 11 to 20 each, 9 per cent could recognize from 21 to 30 each, 3 per cent could recognize from 31 to 40 each, and 3 per cent could recognize from 41 to 50 each.[1]

In this experiment the advertisements within ten pages, either of the cover or of the reading matter, had twice the memory value of those submerged in the body of the advertising sections. Other experiments have led to the belief that the outside cover is probably three times as valuable as any inside position and that all positions within approximately eight pages from the end of the advertising section have greater memory value than other inside positions. Other studies on preferred positions have given the following results. The covers, inside and outside, and the pages next to these are the most valuable. In magazines with the old-style solid section of advertising, the first section has about 25 per cent stronger attention value than the back section. The new style, where advertising borders a column of reading matter, is of far greater value than solid advertisements. The principle of contiguity would force the reader to attend to advertisements he might never otherwise see.

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[1] Starch, D., *Advertising*, 1914, p. 106.

The Size of an Advertisement.—Having placed the advertisement in the book and upon the page we may ask about the space to be used. An analysis of advertising tendencies during the last half century shows clearly enough that the average size of advertisements has been increasing. This may be due to increased funds available, or it may be due to the greater psychological value of large copy. One must consider also the effect of competition and the fact that modern commodities may demand more space.

We are interested here only in the second factor, and we find that, as a matter of fact, the larger the copy the more effective the advertisement. "The general inference which I think may be fairly drawn from all of the experimental work thus far conducted is that, other things being equal, for general display advertising, where the attention is spontaneous rather than voluntary, the full-page unit is apparently the most economical space to use. . . . The conclusion suggested by some of the experimental investigators, that the attention value of space increases more slowly than space itself, that, in other words, small space is more economical in proportion to the area occupied than large space, is true apparently only in the case of advertisements of the classified type. And this is true only of certain types of classified advertising,—for example, mail-order advertising,—in which the attention is voluntary and the customer or reader is definitely interested in searching for a certain commodity and hence looks through all of the advertisements with great care." [1]

Layout.—Layout, in advertising, means the arrangement, the general topography of the printed advertisement. Hundreds of items are included. Rather than indicate results we shall enumerate questions and problems upon the most of which a good deal of experimental work has already been done. Problems of layout include the effectiveness of different sizes of display type, the relation between a headline and the descriptive matter, the size and length of a headline, the relation between the use of decorative and other borders (versus non-borders) and preferred types of eye-movement, the use of other agencies for directing the movement of the eyes, the use of single colors and color combinations (involving contrast, harmony, artistic effect, and the like), the relative value and sizes of squares, circles, ovals, and the golden section, the best way to secure balance in the make-up of the copy, what to place at the optical center of the advertisement, the best ways of representing movement and action, the best type-face for the descriptive or argumentative parts of the copy, the relative value of catch phrases, slogans, and trade-marks, the proper use of illustrations,—here are problems enough to satisfy any experimentally minded person.

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[1] Starch, D., *Principles of Advertising*, p. 563.

Interests and Motives.—An object is attended to, in part, because of its own inherent properties, and, in part, because of the nature of the percipient organism. Where the organism itself expresses a preference for an object we speak of interest. Interests are created, to be sure, by training, but the most of them reveal innate preferences of an individual. Because of these facts the advertiser has made a great many studies upon the relative value of interests and motives. That is, the advertiser means to appeal to the dominant interest, the chief mode of preference of the buyer.

It is obvious that the experimental difficulties which lie in the way of the simpler problems in advertising are multiplied as one approaches the more complex and intricate attitudes and dispositions. The simplest method is to ask readers to evaluate the appeal which any given series of advertisements make. In the following table, for example, we find the statistical results of such a series of judgments. The numbers indicate the relative value of healthfulness as opposed, say, to economy or a recommendation.

TABLE XI

Healthfulness	92	Medicinal	50
Cleanliness	92	Invitation	50
Scientific Construction	88	Elegance	48
Time Saved	84	Courtesy	48
Appetizing	82	Economy	48
Efficiency	82	Affirmation	42
Safety	80	Sport	42
Durability	78	Hospitality	42
Quality	72	Avoid Substitutes	32
Modernity	72	Clan Feeling	18
Family Affection	70	Nobby	16
Reputation of Firm	58	Recommendation	14
Guarantee	58	Social Superiority	12
Sympathy	54	Imported	10
Beautifying	10		

In another study the motives and interests were arranged in the order of merit with the results shown in Table XII.[1]

TABLE XII

Durability	1	Elegance	18	Genuine	35
Sanitary	2	Modern	19	Civic Pride	36
Efficient	3	Hospitality	20	Sale	37
Appetizing	4	Middleman	21	Patriotism	38
Time Saved	5	Courtesy	22	Youth	39
Value	6	Popular	23	Cheap	40
Scientific	7	Growth	24	Recommendation	41
Ambition	8	Hunting	25	Nobly	42
Family Affection	9	Progress	26	Style	43
Safety	10	Quality	27	Excel	44
Evolution	11	Health	28	Royalty	45
Sympathy	12	Amusement	29	Personality	46
Parental Love	13	Bargain	30	Union Made	47
Self-defense	14	Necessary	31	Imported	48
Reputation	15	Social Standing	32	Beauty	49
Guaranteed	16	Stimulating	33	Administration	50
Economize	17	Enormous	34		

Measuring Memory Value.—The psychology of advertising has furnished psychology a more impressive demonstration of the value of repetition in human learning than the laboratory itself has been able to produce. The question which the advertiser asks is: How familiar is the public with the goods I have been advertising?

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[1] See Adams, *op. cit.*, p. 143.

A large number of persons who actually buy goods were asked to answer the question: "What are the following products?" The figures give the percentage of correct answers.[1]

TABLE XIII

	Per Cent Correct		
Products	*Men*	*Women*	*Both*
Bon Ami	90.0	96.3	91.5
Beaver Board	47.8	48.1	47.9
Aeolian	62.2	70.4	64.1
Big Ben	71.1	70.4	70.1
Velvet	85.6	85.2	85.4
B. V. D.	74.4	55.6	70.1
Nabisco	38.9	40.7	39.3
Kohinoor Snaps	5.6	7.4	6.0
Kohinoor Pencils	50.0	51.8	50.4
Pompeian	85.6	92.6	87.2
Prince Albert	88.9	77.8	86.3
Uneeda Biscuit	91.1	100.0	93.2
Zu Zu	46.7	44.5	46.2
Keen Kutter	88.9	88.9	88.9
Alco	71.1	62.9	70.9

In answer to the question "Who says?" the following results were obtained:[2]

TABLE XIV

	Per Cent Correct		
Phrase	*Men*	*Women*	*Both*
You dirty boy	32.2	33.3	32.3
There's a Reason (Postum)	44.4	44.5	44.4
There's a Reason (Grapenuts)	20.00	29.6	22.2
It floats	68.9	77.8	70.9
Good bye old hook and eye	8.9	18.5	11.1
Ask the man who owns me	31.1	29.6	30.8
Chases dirt	66.7	74.1	68.4
One of the 57	66.7	70.4	68.4
99 44/100 per cent pure	41.1	51.8	43.6
Hammer the Hammer	43.3	40.7	42.7
It hasn't scratched yet	66.7	70.5	68.6

The strength of the associative bonds that have been laid down after faithful advertising campaigns is shown by the following experiment. A large number of names of common commercial products were used as stimuli and the subjects were asked to respond with the first associated word. A sample of the results runs as follows: [1]

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[1] Quoted by Adams, *op. cit.*, pp. 178–179.

[2] *Ibid.*, p. 178.

TABLE XV

Stimulus Word	*Responses*	*No.*
Breakfast	Kellogg's	38
	Quaker Oats	6
	Cream of Wheat	4
	Grapenuts	3
	Shredded Wheat	3
	Rolled Oats	1
	Force	1
	National Oats	1
Camera	Eastman	40
	Kodak	14
	Brownie	2
	Premo	1
Canoes	Old Town	44
	Peterboro	3
	Kennebec	1
	Indian	1
	Mullen	1
Chewing Gum	Spearmint	24
	Wrigley	10
	Beechnut	10
	Beeman	10
	Pepsin	4
Cleansers	Old Dutch	56
	Bon Ami	1
Collars	Arrow	53
	Cluett	2
	Corliss K	1
	Tuxedo	1
	Red Man	1
	Lion	1

One of the problems of advertising of more recent interest has to do with trade-mark infringements. This is, obviously, a problem of perception and of associative filling-in. Under controlled conditions observers are required to indicate whether or not the members of a series of trade-names, presented one at a time, are identical with names which have been seen on previous occasions. The following comparisons of the original, the imitation, the percentage of confusion, and the legal decision illustrate the problem.

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[1] Adams, *op. cit.*, p. 184.

TABLE XVI

Original	*Imitation*	*Per Cent Confusion*	*Legal Decision*
Szodont	Kalodont	28	Non-infringement
Nox-all	Non-x-ell	28	Infringement
Club	Chancellor Club	35	Infringement
Bestyette	Veribest	35	Non-infringement
Mother's	Grand-Ma's	38	Non-infringement
An-to-do	Antola	40	Infringement
Peptenzyme	Pinoyzme	43	Non-infringement
Green River	Green Ribbon	50	Infringement
Ceresota	Cressota	63	Infringement

In the table the overlapping of the scores of the infringements and the non-infringements shows that judicial decisions, apart from experimental investigation, are apt to be quite unreliable.

Psychology and Salesmanship.—The psychology of selling, in so far as it is not identical with the problem of advertising, has not got the experimental attention that other commercial problems have earned. The reason probably lies in the fact that in the special act of selling one person is meeting another and there is no convenient way to reduce such a situation to experimental terms. There is also a great amount of popular mystery attached to the operations and formulæ of a man who approaches us with a worthless book and who leaves us with our names upon the dotted line.

Psychology has gone far enough in understanding the minds of a buyer and a salesman to know that there is nothing mysterious or hypnotic in the process. The salesman is a man who knows his goods, who knows and can use language, and who knows the desires and interests of human beings like himself. In a certain sense he is a walking and talking advertisement. If he is acquainted with the facts of psychology he undertakes first of all to attract the attention of a prospective buyer. The means of getting attention and holding it are the same here as they are in any other field of human endeavor. Having secured the attention of a customer his next task is to excite a more permanent interest by linking his product to some fundamental need or desire of the customer. As fast as objections or difficulties arise he has arguments to overcome them. If he has been successful in getting attention his task and his relation to his customer are very like the polarized relation of an audience to a speaker. He has excited a group of ideas and if he can get that group to run over into action without stirring up too many determining tendencies of a conflicting nature his sale is made.

It is in this sense, no doubt, that the successful salesman is said to be a sort of hypnotist. He gets a person so taken up with the advantages of having an object that the difficulties or objections to having it are lulled to sleep. After all, the process is a common one in everyday life. We rarely act in the light of all the knowledge we possess. Attention is a name for a certain kind of selection in which some objects get attended to and other objects are obscured. The art of the salesman lies in saturating an individual with the desire for an object and drying up any reasons he may have had for not purchasing it.

The Selection of Men in Industry

The educator found it costly to put the same type of instruction before a class the members of which might differ from one another in ability in terms of hundreds of per cent. The industrialist has likewise found it costly to take on an unselected group of new employees and wait until they happen to fail or to succeed at the task assigned. The older-fashioned employment bureau was not very helpful in this task. The following extravagant illustration shows the spirit, at least, of old methods of hiring and discharging men. "One large manufacturing establishment has appointed as monarch of the 'hiring-on window' a man who had the misfortune to lose a leg in the company's employ. As a consequence of this loss, he was given his present life job, which he performs to the queen's taste. He was induced to describe his methods and they were something as follows: 'On Mondays I turns down all men with white collars, on Tuesdays all with blue eyes, on Wednesdays all with dark eyes. Red-headed men I never hires, and there do be days when I has a grouch and hires every tenth man.'"[1]

Where hiring is done as one arranges prejudices, there is little hope that a man can be readily fitted to a job or a job to a man. The methods are not so crude, of course, as our illustration would imply, for at the other extreme stand those individuals who are professed character analysts and who insist that they can, with a reasonable degree of accuracy, select men best adapted for a given kind of work. We have already examined the materials with which the character analyst works, and while it is probable that a "character reader" quite familiar with the changes which training has wrought upon the person of an individual, may strike, now and then, a fair degree of success, nevertheless his method is far from ideal, as the continued high percentage of turnover in industries, manned by such methods, will testify. Where the acceptance or rejection of a man for a place is so apt to be affected by one's mood, one's religious prejudices, difference in race and the like, there is no hope that the selection of men will ever become very reliable in the hands of professional character analysts.

The Task and the Talents.—The workers in an industry achieve success or fail because they are or are not fitted by training to do the sort of thing they have been instructed to do. It would be surprising indeed if an industry which may spend millions of dollars in the improvement of its plant and of its machines and in the economical division of labor, should fail to measure accurately the psychophysical abilities of the individuals in whose hands the instruments are placed. One of the problems of the psychologist interested in industry begins, then, to appear. He finds, on the one hand, a machine which must, if it pays for itself, run at a fairly high speed. He finds

[1] Quoted by Link, H. C., *Employment Psychology*, 1919, p. 14.

that the operator of that machine must make a certain number of coördinated movements, his visual apprehension must be good, and these, and other mental and physical factors, must be optimally coördinated in the attainment of a good product with a minimal expenditure of time. On the other hand, there is the task of finding a man whose psychophysical qualifications are adequate to the task set. If both parts of this problem are not carefully determined the result is a poor product and an uneconomical use of time and of man-power.

A sample of what the industrial psychologist does will satisfy our present interest. He has, first, to make a survey of the types of work for which applicants are being chosen. He then selects one or two operations and studies them intensively in order to discover what general mental abilities are needed in carrying out successfully the designated operation. A third step consists in devising and administering to a large number of successful operators a series of tests which may be taken as substitutes for or measures of actual performance in the shop. Degrees of correlation between performances in the tests and performances at the machine are then worked out and those tests which rank high with respect to excellent achievement in manipulating a machine are reserved for further testing. Where the conditions will permit, the tests are then given to a fairly large number of prospective employees. Those passing high in the tests are given a machine to operate and their degree of success or failure is carefully watched. If a sufficiently large percentage of those receiving high grades in the test actually achieve a high degree of success in operating their machines, and if, on the contrary, a sufficiently large number of those failing in the tests also fail in their ability to operate their machines, the investigator in charge can feel fairly certain that his measures are sufficiently reliable to take the place of the methods of selection we have described above. It frequently happens, of course, that the tests fail to correlate well with actual ability in operating any given machine. In this case further tests are devised and studies are continued until successful tests have been found.[1]

A Typical Experiment.—The ideal procedure which we have just outlined varies widely, of course, with industrial psychologists and with the conditions which have to be met and the difficulties which must be overcome. Fortunately, however, a few men with a fair amount of psychological training are taking problems of this kind seriously and the outcome is constituting a real contribution to the mental aspects of industry. A single illustration will show the character of the studies that are made and will give a sample of the results that have been secured. A man who has had considerable success in applying trade tests to industry has described the analysis he made of the task of inspecting unloaded shells. The inspections he describes were done in two long well-lighted rooms by over three hundred girls. An analysis of the operations through which the girls went in inspecting the shells revealed the fact that several distinct abilities were involved in the performance. The defects in the shells were often so small as to require a high degree of visual discrimination. The defective shells must be quickly and accurately apprehended, a task made possible only by the best sort of visual equipment. The second sort of performance consisted of extracting as rapidly as possible the defective shells and of throwing them into any one of a number of boxes, depending upon the sort of imperfection discovered. The movement must not only be made quickly but accurately. The defective shells had to be selected from a large handful and their deposition in the right discard box required a fairly high degree of motor coördination. The whole period of examination involved a high degree of attentive organization. That is to say, attention must of necessity be steady since the least change in clearness among the relevant tasks may easily result in missing defective shells.

In this particular instance, sixteen tests of intellectual ability were selected. There was a test of visual acuity, a card-sorting test, a cancellation test, a number-checking test, a modified form of the tapping test, an accuracy test, a steadiness test, and so on. The performance of the inspectors in these tests was set against an average of their work for four weeks and degrees of correlation quickly determined the availability of some of the tests in this particular field. The value of the tests was soon indicated by the transfer of 800 out of 2,900 applicants to work other than that of inspection. An analysis of the successes achieved by those passing the tests revealed in a striking manner the availability of tests of intellectual talent in selecting individuals to execute a given kind of task.[1]

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[1] Read Kornhauser, A. W., and Kingsbury, F. A., *Psychological Tests in Business*, 1924.

The Selection of Leaders.—It is as yet too early to tell how far the administration of tests can go in selecting men for industrial performances. Up to the present time fruitful tests have been applied to inspectors, assemblers, machine operators, office clerks, stenographers, computing-machine operators, and the like. This, of course, is only a beginning when one realizes that several hundred different occupations have been distinguished and listed. There seems to be no doubt, however, that one can simulate, in the laboratory, certain of the conditions that obtain in the shop or the foundry, and construct simple tasks and performances success in which will imply success in industry. It has become customary, however, for certain reactionaries to ask how one can measure interest and desire to work, and the motives which keep one at tasks that are, in themselves, either monotonous and mechanical or actually unpleasant. Or they will inquire whether there are any tests which "will make it possible to discover men of large caliber and large capabilities; men who have the ability to plan and execute great projects. . . ." The first objection is, of course, serious and implies that one of the tasks ahead of the industrial psychologist and of the sympathetic employer is that of creating motives, of building pleasant workshops, of surrounding workmen with opportunities which will create and sustain interests.

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[1] See Link, H. C., *Employment Psychology*, 1919, Chap. ii.

But with interests and motives given the rest of the task follows easily. The second question must be answered in the negative save in so far as indices of general intelligence are refined and made indicative of the kind of ability necessary in the foreman, the engineer, the department head, or the executive.

Tests of intellectual talent do not make it possible to discover all that might be known about an individual. "The application of psychological tests does not make it possible to predict, without qualification, that a certain individual will succeed at a certain kind of work and that another will fail. They only enable one to say that the chances for success of a particular individual or group are better than the chances of another." The tests relate, moreover, to certain definite intellectual capabilities; they do not relate to such gross things as ambition, reliability, enthusiasm, punctuality, honesty, cheerfulness, tact, deliberation, and the like. It is obvious, however, that these are qualities which will manifest themselves in performance *after* the question of specific performance is settled. No amount of ambition will ever overcome the handicap presented by one's physiological limit in motor coördination. No amount of interest and zeal will ever overcome inadequate visual acuity. The place, then, of tests of intellectual talent is fairly definite and if they can survive too much advertising and too much premature application, there is no doubt but that they will prove a real contribution to industrial problems.

THE HUMAN BEING AT WORK

The child of dull intellect that is punished because it did not choose to learn is a tragedy of the days when efficiency was thought to be a product of will power or of determination. The man of slow reaction time and of low talent in motor coordination, who lost his job because he could not keep pace with his motor-driven machine, is another tragedy of a modern industry which does not pay respect to the scientific selection of men. The tragedy becomes still greater when the industry does not trace failure to other equally important causes, viz., to conditions which determine the limits of efficiency. Wilfulness is not the secret of labor troubles.[1]

The Problem.—Given a wide variety of hereditary and acquired modes of response we must ask what conditions make them more or less serviceable in the business of living. That is to say, how efficient is the organism when it reaches maturity? In general it may be said that, save as drugs, lack of oxygen, emotional disturbances, or sudden changes in environment induce temporary fluctuations in efficiency, most of the well-organized reaction patterns change but little after they have been established. They are not repeated often enough to produce a high degree of skill but, nevertheless, there are enough repetitions to eliminate serious deteriorations as in forgetting. In other words, the organism is very apt to reach a plateau in the formation of habits and it is upon this plateau that most of its performances rest.

Fatigue.—It is necessary, however, to consider the causes of temporary changes in efficiency. Under fatigue, for example, motor efficiency may be greatly reduced. Studies on fatigue gain significance usually with respect to the work curve, a schematic device which represents the quantity or the quality of work done in a given interval of time. The work curve is characterized at its initiation by either (*a*) an initial spurt in which the organism sets a higher goal than it can consistently reach, or (*b*) by a warming-up period in which the muscles attain only gradually the highest level of efficiency. The conditions which contribute to the one or the other of these initial aspects of the work curve are not fully known. The latter part of a work curve presents a fairly consistent decline which is said to be due to fatigue. There may be, under prolonged activity, structural or chemical changes in the nerve fibers or in the nerve cell, but the chief product of muscular activity, carbon dioxide (CO_2) is more often cited as the cause of fatigue. Carbon dioxide, lactic acid, and possibly potassium phosphate are thought to be carried to the muscles and so decrease the amount of work they are capable of doing.

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[1] Read Watson, J. B., *Psychology*, 1924, Chap. X.

Drugs.—Drugs are also alleged to affect the work curve. Although there is a wide variation in the amount of alcohol which a person may consume without affecting general capacity (20 cc.–40 cc. of absolute alcohol), a certain amount appears to depress the reflexes and act deleteriously upon all forms of muscular work. Caffeine appears to increase the capacity for work, the stimulation persisting for some time after consumption. There is little evidence that there is a reaction characterized by a diminished capacity for work. Tobacco, like alcohol, appears to lower efficiency although no adequate control has yet been devised for experiments in this field.

Ventilation, temperature, and humidity produce very serious changes in the work curve. A summary of studies upon the problem appears to show that optimal conditions for work are 68° F., 50 per cent relative humidity, and 45 cubic feet of outside air per person per minute. Lack of oxygen, as at high altitudes, results in a lowering of efficiency. Well-established habits become disorganized until finally, with extreme deprivation, asphyxiation occurs. A great variety of other studies upon such matters as the diurnal course of motor efficiency, the effects of prolonged fast, the effect of distraction (conflicting stimuli), favorable physical conditions (illumination, color schemes), sex differences in the capacity to work, and the like, illustrate still more completely this aspect of psychotechnology.

Food and Efficiency.—Large researches upon the relation of food to efficiency have brought forth many facts. Recent studies on this problem have been incited in part because of the restricted diet that comes with war times. Under reduced diet in which the body is made to lose about one-tenth of its normal weight there are no pronounced changes in the ordinary temperature control exhibited by normal individuals; but heart action is profoundly influenced. In some cases the diastolic pressure falls below the "shock level" found in cases of surgical shock. On the whole there is a general lowering in the level of pulse rate; but there is no sign that the functional efficiency of the heart to meet the needs of circulation of the organism under rest and activity is impaired. Respiration rate is not materially influenced by the period of low diet. Changes in the intellectual talents under low diet can be seen in the following table.[1]

TABLE XVII

(1) Accuracy in tracing. Less accurate work and less rapid improvement.
(2) Pitch discrimination. Slightly poorer near the threshold.
(3) Number cancellation. Slower improvement.
(4) Addition. Slower improvement in accuracy.
(5) Memory span. No certain change.
(6) Strength of grip. Definitely lowered.
(7) Pulse with exertion. Lowered level of pulse-rate, nothing pathological.
(8) Patellar reflex. Slightly depressed.
(9) Eye reactions. Not significantly changed.
(10) Word reactions. Not significantly changed.
(11) Number reactions. Not changed.
(12) Visual threshold. Efficiency not decreased.
(13) Electrical threshold. Less sensitive and less improvement.
(14) Eye movements. Slower speed.
(15) Finger movements. Slower speed, no indication of quicker fatigue.
(16) Maze performance. Not significantly changed.
(17) Clerical tasks. Slower improvement.

Restricted diet seems in general to disturb motor coördination and to slow up the capacity to make improvement in the higher mental capacities. None of the changes are pathological and none of them are so great as to weaken the conclusion that under prolonged low diet the organism is wonderfully able to adjust itself and to maintain itself at a fairly high functional level. There were some reports that insufficient diet led to irritation, to scattered attention and to greater susceptibility to annoyance; but there were also cases where mental life seemed quickened and clearer. The subjects of the experiment were relieved "from the annoying tendency to sleep after meals" and in many cases the scholastic average of the men under limited diet was better than normal eaters.

Rest Periods.—Increasing attention is being paid to the relation between amount of work done and short rest periods.

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[1] Benedict, F. G., and others. *Human Vitality and Efficiency under Prolonged Restricted Diet*, 1919, p. 637.

It is unfortunate that we have not taken a few lessons in the art of happy and long-continued work from our own hearts. From the third month of fœtal life until the hour of death the heart keeps at work; but not continuously, for between every contraction there is a moment of complete rest. In the long run there is more rest than actual work and yet in the long run no living organ gets more done than our hearts. It can be shown that if the heart were kept at its work without a rest it would soon wear itself out. Muscles under electrical stimulation soon become inert.

It does not often happen that so much undisputed evidence can be brought to bear in favor of a single proposition as can be brought to bear on this, viz., that the more often a period of sustained work, be it scrimmage or running or what not, is broken by rest periods,—even if for only a minute or two,—the less will be the damage of exhaustion.

For an illustration of this fact outside of athletics we may go to an industry. At a certain factory "there was recently constructed a long incline up which heavy loads were to be wheeled in barrows, and premiums were offered to the men who did or exceeded a certain amount of this labor. They attempted it vigorously, but none succeeded in earning any of the extra money; instead, they all fell considerably below the fixed task.

"Prompt investigation by an expert disclosed that the trouble lay in the fact that the men were working without sufficiently frequent periods of rest. Thereupon, a foreman was stationed by a clock, and every twelve minutes he blew a whistle. At the sound every barrowman stopped where he was, sat down on his barrow, and rested for three minutes. The first hour after that was done showed a remarkable change for the better in accomplishment; the second day the men all made the premium allowance by doing more than what had been too much; and on the third day the minimum compensation had risen, on the average, 40 per cent., with no complaints of overdriving from any of the force."

In another experiment workmen who, at their own gait, had been producing 16 pieces an hour, were given a schedule of 25 minutes of work and 5 minutes of rest. They averaged 18 pieces an hour as a result. After a change from 17 minutes of work and 3 minutes of rest, the output rose to 22 pieces per hour. A 10-minute work period and a 2-minute rest period brought an increase of 25 pieces per hour. In still another case men who had been driving 600 rivets per day made records of 1,600 per day by the insertion of a 2-minute rest period between every ten rivets.[1] These facts speak for themselves.

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[1] Jones, E. F., *The Administration of Industrial Enterprises*, 1919. (Longmans, Green & Co.)

CHAPTER XXIII

SPECIAL TECHNOLOGICAL PROBLEMS

Introduction.—We have now seen how psychological facts may be used in the fields of education, law, medicine, commerce, and industry; but the growing significance of the science in its contributions to practical life warrants the citation of a few more samples from the field at large, samples that do not readily fall under the more formal topics already discussed. We shall choose for further illustrations of the problems of psychotechnology the application of psychology to war, to music, to legibility of printed matter and to athletics. Here are practical problems wholly different from one another. Let us see what psychology has to offer in understanding them.

Psychology and War

One of the greatest successes of psychology in the field of applied science was attained under the recent reorganization of psychological facts and laws for use in the World War. We have space only for an outline of some of the more significant points of contact and some of the most outstanding accomplishments of the last few years.[1]

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[1] The problems of military psychology as envisaged before the Great War are summarized by Yerkers in the following places: "Psychology and the National Service," *Psychol. Bull.*, 1917, 14, 259–263; *J. of Appl. Psychol.*, 1917, 1, 301–304; "Psychology in Relation to the War," *Psychol. Rev.*, 1918, 25, 85–115. The results of the tests for military selection appear in the Memoires of the National Academy of Sciences, 1921, 15, 1–890. The subject of morale has been treated extensively by G. S. Hall, *Psychol. Bull.*, 1918, 15, 361–426. The Air Service Medical (Gov. Printing Office) reveals the interests of psychology in aviation. The tremendous literature which has appeared relating to war-time mental disorders can be located by appealing to the *Psychological Index*, an annual bibliography of psychology and related sciences. The chief contributions of psychology to the conduct of the war have been reviewed by Yerkes in *The New World of Science*, 1920, section on "The Rôle of Psychology in the War," pp. 351–389.

The Psychological Causes of War.—Nations go to war for three major reasons. There are, first of all, certain economic and political causes of war. Populations grow beyond the resources of a country and industries demand new sources of supply and new markets. Politicians play their games to achieve advantages in lands and goods, and nations are brought into conflict because of them. Newspapers and journals, displays, parades, military museums, and exhibitions are useful instruments in the spreading of national needs and aims, or of actually inciting one group against a neighboring group. There are, of course, certain secondary psychological problems in these causes of war, problems which have to do with the nature of patriotism, the meaning of propaganda, best modes of exciting envy, jealousy, fear, and the like; but we must hasten on to problems which are even more distinctively psychological.

War owes its origin, in the second place, to social and political traditions. It has become almost a tradition for nations to maintain large military establishments which are frequently a perpetual invitation to battle. Religious dogmas of long standing, perverted educational systems and provincial historical references, compulsory military service, legislative enactments which were once important but which have become insignificant as the need for them has disappeared, are examples of traditional influences or social heritages which lend themselves readily to war. Here again there are certain secondary problems of interest to psychology; but we must pass them by.

War depends, in the third place, upon the arousal of certain instinctive tendencies and it is here that psychology finds its most important problems. It has sometimes been alleged that there is a specific combative, pugnacious instinct. If not, there are other inherited tendencies potent enough to bring about war. The instinct of fear, under social modification, lends itself easily to military propaganda. Jealousy in the form of race hatred or misunderstanding, vengeance, hero-worship, emulation, and imitation are other tendencies that contribute materially to a psychobiological basis for war. A number of long studies have appeared in the last decade which treat of these conditions of fighting and some of them have contributed much material to an understanding of racial conduct and of social and political enmities.

Psychological Problems in Military Operation.—Psychology is most interested in a variety of problems having to do with actual military operations. There are, as a matter of fact, five general problems, (*a*) military selection, (*b*) military instruction, (*c*) motivation and maintenance, (*d*) mental and nervous rehabilitation, and (*e*) the application of specific psychological facts to military operation and achievement.

Military Selection.—The first problem, military selection, involves, in general, an enumeration and a psychological analysis of all of the tasks which constitute military service, a parallel analysis of the capabilities of all members of society available for military service, and an appropriate adjustment of the one to the other. It is impossible to go into the details of this contribution to military service for the record of only one part of it fills a volume of nearly a thousand pages; but we have already sensed on p. 488 the scope of this movement.

During the recent war over two million men were given tests of general mental ability and the selection of individuals for different branches of the service accorded with their respective mental ratings. In addition to this wholesale selection, special tests were devised in order to distinguish individuals for specific branches of military service, such as the aviation service and the intelligence service. Trade tests and other suitable devices for measuring achievement as well as ability were instituted in order to take care of the large number of accessory tasks in army operation (see p. 491).

Military Instruction.—The second problem is the problem of military instruction. Even the general infantry service, to say nothing of the artillery, aviation, and naval services, requires a long process of training in which an individual has to learn how to leave friends and relatives, forsake old habits, emotional sets and dispositions, and become a new type of person. He must, moreover, acquire a great amount of technical information, such as is required, for example, in plotting the trajectory of shells or in equipping himself to enter the intelligence service. In countries without universal military training the problem of military instruction is proportionately more serious, for military preparation must proceed with great rapidity when that country is suddenly thrown into war. The new soldier must learn to handle his gun, his bayonet, and his trenching tools. He must learn the rules of warfare, he must be imbued with a fighting spirit, he must learn how to bring to his own welfare every mental and physical capacity which nature has given him.

Instruction of a certain sort must be directed toward the civilian population as well. For military and political reasons, information must be censored, mental attitudes built up, financial, Red Cross, and other campaigns carried through to a conclusion and many other methods instituted to maintain the sympathy and support of noncombatants. War then, implies a tremendous educational program, taxing to the limit the pedagogical facts we have already surveyed in Chapter XIX.

Morale.—The third general problem has to do with the maintenance of morale. Wars are not finished in a day. Just as the physical resources of a nation at war have to be husbanded so ought the psychological resources to be guarded. Morale is an undefinable sort of attitude and yet we readily recognize the meaning of the term. It was morale that kept the Germans out of Verdun. It was lack of morale that broke the Russian army into pieces at a critical time in the World War. Morale has to be sustained in the army and in the civilian population. The "will to carry through," the "determination to endure until the end" are phrases that hint at the psychophysical character of this important part of wartime psychology.

Reëducation and Rehabilitation.—The fourth general problem concerns the reëducation or rehabilitation of men suffering from functional diseases brought on by military service. Some of these, together with methods of curing them, have already been discussed in the paragraphs on diseased and disordered minds, and on psychology and medicine.

Special Problems.—The fifth problem has to do with the application of specific psychological facts to military service. Problems of sound localization and of the estimation of distances, devices for improving visual acuity, the psychophysical limits to which signaling systems must be adapted, the effects of low oxygen (while flying at high altitudes) upon mental ability, and problems of mental fatigue illustrate the wide range of interest which the psychologist has in military operations. One of the most important special problems had to do with the selection of men for the air service. It was discovered that successful flight depended upon the functional integrity of the organs of balance and upon other capacities of the highest order. The problem of testing the organs of balance and of selecting appropriate intellectual talents became, therefore, a very pretty piece of psychotechnology.

Problems of Demobilization.—There are, finally, a number of mental problems following war. After demobilization, people as well as goods and implements are returning to civilian life. The individual has to be reabsorbed into society and the problem is difficult, for war distorts points of view and it sets a person at odds with society. The organism has become accustomed to strange habits, hideous sights, sounds, and emotions, and unusual mental and physical exercise, and no small part of the process of demobilization is, then, a problem of psychological reconstruction. Furthermore, since psychology is the science of mental life, and since war in its origin and in its actual operations is partly mental, the problem of doing away with war must be partially a psychological problem. Whether there is a moral or intellectual equivalent to war is yet to be seen; but if there is, the psychologist ought to assist in finding it, and help to institute it.

So short a summary as this does a certain injustice to the contributions of psychology to war when it is generally known that these contributions were almost, if not quite, as significant as those of any other science. We have, however, illustrated some of the problems and stated the general character of the services the science rendered.

PROBLEMS IN LEGIBILITY

Our next example of special technological problems in psychology has to do with legibility. The lines you are now reading are examples of the material with which legibility is concerned. Reading is a complicated process, for it involves (*a*) complex movements of the eyes as they leap and pause from point to point along a line; (*b*) the arousal of associative tendencies, the formation of meanings, and the setting up of certain bodily postures and organic sets; and (*c*) the apprehension of curious little black marks on a white sheet of paper, an intellectual accomplishment which depends upon such typographical conditions as the color and lighting of the page and of the print, the size and form of the type, the length of the line, and the spacing of the letters.

Experimental Problems.—All of the conditions underlying reading, which we have just enumerated, have set before the psychologist serious experimental tasks. Some of them he has solved; but others still await adequate laboratory formulation. Enough has been done to show that the printer of the future must know how long a printed line should be, how large the type, how far apart the lines, how large the pages, in order to insure optimal reading conditions. He must know more than this, for he must understand how far each of the conditions we have named may be modified with respect to one another in order to produce a book of light weight and of convenient size at moderate cost. In other words, the inquiry means: What are the optimal conditions under which reading can continue where value is being placed upon the time consumed, the degree of eyestrain, the sense or meaning of the material read, and the cost of publication. The problem is fairly serious, for the printing of many books, the increasing dependence of individuals upon information carried by the printed page, and the alleged alarming increase in ocular troubles, each demand knowledge of the conditions surrounding legibility.

Leading.—For our first illustration we shall choose a single condition of legibility, viz., the amount of leading or the vertical distance between two successive lines of printed matter. The problem of leading is important, for the structure of the eyes and the muscular coördinations to which they are subject suggest that the ocular mechanism may function better in making some types of movements rather than others. In reading, the eyes must follow one line across the page and, upon returning, pick up the beginning of the next line with a minimal loss of time. The problem of leading implies that there may be a ratio expressing optimal relations between the length of a line and the space separating the lines, and it is probable that the discovery of this ratio will be reflected in a decrease in the time of reading, if not in other indices of favorable perceptual conditions.

The type face used in the experiments we are now to describe was similar to what is known as "news gothic," a style which had been found to stand relatively high in legibility in other studies. Blocks of reading matter of the same length and approximately of the same difficulty were printed upon heavy cards. The blocks were printed in 12-point, 9-point, and 6-point type and the leading varied from 0 to 9. The cards containing the blocks of printed matter were mounted and read under carefully controlled conditions. The reading distance was varied, reading-times were taken, errors and introspections recorded, and by statistical treatment the optimal amount of leading was discovered. A preliminary report of these studies shows that a line about three and five-sixteenths inches long, separated from other lines by seven leads, printed in "news gothic," and perceived from almost any reasonable distance, is being read under optimal conditions. Unleaded or closely set matter was read with relative slowness. The rate of reading increased with an increase of the interlinear space up to 7-point leading (about $^1/_{10}$ of an inch) and then rapidly declined.[1]

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[1] Bentley, M., *Psychol. Monog.*, 1921, Vol. 30 (No. 136), pp. 48–61.

Optimal Conditions for Telephone Book.—There are several other problems in legibility related more definitely to business. A short time ago, for example, the New York Telephone Company found its directory expanding beyond the limits of an easily-handled volume. In trying to solve their problems several possibilities appeared. It was suggested (*a*) that the size of the book could be decreased by decreasing the size of the type used; (*b*) that the telephone numbers might be placed in two volumes; and (*c*) that the names and addresses might be further abbreviated. It was not known, however, what effect these changes might have upon the number of errors made by subscribers and the company was not inclined to increase the expense of the directory. The problem, then, was to find an optimal size of type, an optimal number of names to a column, and an optimal number of pages to a book in order to insure adequate perception and moderate expense. The problem was placed in a psychological laboratory and the director of the laboratory set his assistants at work. The result of the investigation was the discovery of a mode of printing, including size and spacing, that admitted not only of rapid reading but of an actual decrease in errors and in the size of the directory notwithstanding the larger number of names to be included. To be explicit, the new directory issued under the experimental results from the laboratory was not only more legible than the old by more than 10 per cent, but it also was reduced in bulk by approximately 20 per cent, which meant a decrease of about two hundred pages.[1]

Let us take another example in order to illustrate the many problems of perception that have to be answered for practical purposes.[2] For many years the Postal Service has made it a practice to recommend the following form of address upon envelopes:

Mr. John T. Doe,
4687 South Water St.,
Chicago, Ill.

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[1] Baird, J. W., *J. Appl. Psychol.*, 1917, Vol. 1, pp. 30–37.

[2] From an unpublished experiment by the author.

But with the development of typewriters having automatic stops and an automatic return for the carriage, it became much easier to put the address in some such form as this:

Mr. John T. Doe,
4687 South Water St.,
Chicago, Illinois.

Even the following form was adopted on a good many letters:

Chicago, Ill.
Mr. John T. Doe,
4687 South Water St.

Now the men in the postal service principally involved in this problem are the railway postal clerks and local clerks who are obliged to distribute letters rapidly into compartments, sacks, or boxes according to states, cities, and street numbers. It becomes an important matter, therefore, to post-office employees to have addresses set down in the most legible fashion possible. To this end it was necessary to arrange a typical distribution box and, under experimental conditions, to distribute letters to their respective compartments. Relevant time intervals were measured, introspective accounts taken, and under statistical treatment the optimal mode of address appeared. So far as the investigation has gone the second form of address given above is quite preferable to the others. Obviously it is impossible to set down upon a single envelope the form of an address most suitable to a clerk who is distributing by cities and by states, and at the same time furnish optimal conditions for the clerk who must distribute by names, by streets, and by numbers. It ought to be possible, however, to arrive at a combination of factors, as in the third form of address, more advantageous to both groups of men than the original form.

Psychology and Music

The creation and the enjoyment of music reflects a talent on the part of human beings that stands unique among their other talents. The pianist, for example, sets himself before an instrument made up of a large number of keys and his task is to strike the keys in such a way that harmony and melody result. He reads from a page black objects scattered here and there upon a staff and he interprets these objects in the form of intricate and sometimes extremely rapid muscular movements of a complicated and highly coördinated sort. Out of his "mind's eye" or his "mind's ear" he brings tones and groups of tones together in simultaneous and successive arrangements and gives to his auditors a delightful melody. His hearers sit before him and are moved as he is moved, now under the soft, quiet strains of a pastoral, or again under the stirring blasts of martial music. On one occasion he may almost see the riding Valkyries and again he may hear murmuring brooks and soft whispers of the wind in the trees. What, then, is music and what has the psychologist to do with it? [1]

The Problems.—The psychological problem is fourfold. There is, first of all, the problem of the origin of music. The second problem has to do with the listener and his enjoyment of music as it is produced. This part of the problem consists largely of a study of the emotions although the psychophysical conditions of tonal fusion and melodic sequence must be understood. Psychology asks how it is that the ear can single out thirty or forty different tonal qualities and yet, at the same time, integrate them into an affectively pleasant pattern. The third problem has to do with the production of music, as in writing it, or in operating musical instruments or in singing. The fourth problem is the most important for our present chapter, for it has to do with the practical problem of searching out and developing "musical ability." A number of tests have been devised to measure the musical ability of children and of adults and other measures have been made of related abilities.

The Origin of Music.—Four theories have been advanced to explain the origin of music. Pursuant to his reflections on a theory of evolution, Spencer asserted that music originated in the love calls of animals and of birds. There is, however, not enough evidence, even from nature, to warrant this assumption. Others have urged that the concerted work of many individuals necessitated rhythm and so the expression of temporal sequences. But music involves also consonance. A third theory, accordingly, makes use of natural differences in the pitch of human voices. It frequently happens that the speaking voices of several individuals may harmonize in a rather pleasant manner. A fourth theory proposes that in the beginning the fact of music existed as inherent to the nature and functions of the nervous system. The ear is an analytical mechanism and the very way it is made contributes to the perception of harmony, sequence, and fusion. The vocal cords, like any other muscles, are always in different states of contraction and the wind rushing by them brings about sound without much conscious intent. The discovery of musical instruments, like the discovery of any implement, was probably an accident.

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[1] Consult Seashore, C. E., *Psychology of Musical Talent*, 1919.

None of the theories is wholly satisfactory; but in the meantime a large number of studies of primitive music are being made and, without doubt, the results will finally be significant for understanding the origin of music. Already hundreds of phonographic records are on hand preserving to students for all time the music of primitive peoples, and out of the analysis of these records must come the facts of rhythm, of sequence, and of melody which may explain the origins of primitive music.

Absolute Pitch.—A second problem of psychology and music has to do with a study of the listener. What intellectual talents contribute to the experience and what typical attitudes appear? One of the most striking facts in this connection is the ability of certain individuals to distinguish pitch values directly. Most individuals are quite unable to state, even approximately, the pitch of a note, although some may relate it to another note or to a point on the piano keyboard. That is to say, they distinguish tones as either high or low upon the tonal scale or at the very best name the octave to which they belong. There are a few individuals, however, who can identify pitch immediately without resorting to any association or to any modes of comparison. The individual who distinguishes "absolute" pitch perceives the pitch as a part of the note. A given tone means middle C just as a color is red. The pitch for him is an integral part of the perception.[1]

"Colored Hearing."—The most interesting of the unusual phenomena in music is the fact of chromæsthesia or "colored hearing." The individual enjoying such an experience perceives sounds clothed with color. Here again the perception of the sound as colored is immediate and not a mere association. A certain note is just as much blue as a certain taste is sweet. Experiment shows that these "colored tones" last over a term of years without becoming materially modified. Letters and words also bear confusions of the same kind. One of the earliest cases, described by one of Galton's correspondents, runs as follows:

"The vowels of the English language always appear to me, when I think of them, as possessing certain colours. Consonants, when thought of by themselves, are of a purplish-black; but when I think of a whole word, the colour of the consonants tends towards the colour of the vowels. For example, in the word 'Tuesday,' when I think of each letter separately, the consonants are purplish-black, *u* is a light dove colour, *e* is a pale emerald green, and *a* is yellow; but when I think of the whole word together, the first part is a light grey-green, and the latter part yellow. Each word is a distinct whole. I have always associated the same colours with the same letters, and no effort will change the colour of one letter, transferring it to another."[2]

Emotions Aroused by Music.—The emotional attitudes of the listener in music are now being subjected to experimental analysis. Musical compositions are said to be calming, exciting, stirring, moody, depressing, joyful, angry, and the like. It has been affirmed that for every mood, emotion, or passion, there is a corresponding type of musical composition. There can be no doubt about the fact that music does bear some relation to emotion; but it is not clear as to whether the emotional qualities are part of the perception of music or whether we have learned to associate various moods with various kinds of music. Experimental studies reveal the fact that music is often accompanied by changes in distribution of the blood, in the rate of heartbeat, and in the character of respiration. It has been discovered that moods are frequently conditioned by the timbre of various instruments, by variances of tone, by rhythms, and by the arousal of associative patterns (usually visual). Many attempts have been made to distinguish types of listeners. The analytic type, for example, habitually subjects musical composition and performance to critical analysis. The motor type is alleged to make consistent vocal or other muscular accompaniments to music. The imaginative types find in music a stimulus to the free use of imaginal processes. Emotional types enjoy music principally because of the affective dispositions initiated by strains and melodies. Other types have been described, but so far it has not been shown that there is anything final in such distinctions. Too frequently the attitude of the listener toward a single composition changes from day to day.

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[1] Baird, J. W., *Memory for Absolute Pitch.* Titchener Commemorative Volume, 1917, pp. 43–78.

[2] Galton, F., *Inquiries into Human Faculty and Its Development*, 1883, p. 149.

The Creation of Music.—These, then, are some of the problems that concern the listener. Now what shall be said of the performer? In this part of the problem, we are still without a great many facts. We do know some of the conditions underlying the physiological limit of "trilling" movements and we know also some of the principles involved in establishing the kind of habits necessary for the manipulation of musical instruments.

This phase of the production of music is fairly simple. The other phase, the composing of music, is another problem. There are at least two types of composers. The first type owe their music to the more or less spontaneous appearance of melodies which sing their way into existence in the "mind's ear" of the composer, while others must labor with harmonic analysis and solfeggio much as one would work with mathematical symbols. But biography and anecdote do not solve psychological problems. The creation or composition of music has scarcely been touched by experimental methods.

Tests of Musical Aptitude.—Recently tests and scales measuring musical aptitude have been devised. Among the performances to be tested are acuity of hearing, loudness, discrimination, singing key, singing interval, voice control, register of voice, quality of voice, sense of rhythm and of time, musical appreciation, musical expression, tonal imagery, appreciation of consonance and dissonance, rapidity of motor adjustments, voluntary motor control, and so on. Studies of this kind have necessitated the construction of such pieces of apparatus as the tonoscope, a device for measuring the pitch of the voice, and the pitch range audiometer, a device for measuring the range of audition of prospective musicians. One of the large companies producing phonograph records has issued a number of records containing tests of musical aptitude.

Psychology and Athletics

It has been recognized for a long time that the athletic field is a splendid laboratory for the study of physiological problems, problems of work, muscular efficiency, oxidation, and the like. More recently the athletic field has also been viewed as a splendid laboratory for the study of certain psychological problems and as a result an increasing number of special studies is being made upon all the phases of athletic skill.

The Meaning of Individual Differences in Athletics.—Individual differences play the same significant rôle in athletic competition as elsewhere. Let us assume that a coach has a squad of twenty men, all of whom must learn a tremendous number of facts about playing the game and who must, at the same time, acquire an incredible degree of skill in several types of muscular movement. An open-field runner, for example, must learn how to change pace quickly, how to pivot without losing his balance, how to straight-arm a tackler without losing his grasp of the ball, and how to twist and turn his body after being tackled without falling to the ground. Now as we already know from previous discussions, the aptitude of a group of men in learning such skills may vary as much as four- or fivefold. A team will learn only as fast as the slowest man on the squad and it will acquire skill in blocking, not only with respect to the talent of each member of the team, but with respect to the talent of the man they are to protect after he gets through the line. Then, again the whole tactics of a season, the style of play, the type of formation from which plays are to be run, may vary with the talents of the men who appear year after year. If the men are fast but light, a running offensive may be indicated. If they are heavy and slow, a plunging style of attack may be indicated. Men of exceptional talent often have a whole team built around them, while a group of men of approximately equal talent are trained as a unit. The fact of individual differences is, therefore of considerable importance to the coach.

Psychological Problems in Athletics.—The psychologist may make three different contributions to the profession of coaching. As intimated above he may institute experiments and tests designed to search out special athletic aptitudes or special weaknesses and thus enable the coach to formulate more quickly his program of training. At present he uses the somewhat wasteful method of watching the men for two or three weeks before he is able to select those who will be particularly useful to him. This task of the psychologist is altogether similar to the parallel problem in industry. It is assumed that some study has already been made of the talents necessary to become a skillful open-field runner or a skillful basket shooter or a skillful batsman. One might then attempt to search out individuals having special talents adequate to the tasks to be assigned.

A second field of usefulness for the psychologist has been the interpretation of psychological fact so that coaches and athletes may make use of what is already known in the field. There is, for example, a tremendous amount of information available concerning the best methods of acquiring a skill. Conditions of learning, that is of effective presentation, the most effective distribution of practice periods, favorable organic and environmental conditions, have been studied at length and these facts may, under certain precautions, be turned to account on the athletic field.

There are, in the third place, new problems that demand original research. Not all of the facts of learning, for example, hold true under the conditions which obtain on the athletic field. In these cases it is necessary to institute new experiments in order to fix the unknown conditions. A single illustration may suffice. The skill of a basket shooter rests upon a unique type of motor background. Most of his shots are made while the body is in rapid motion and no two shots are ever made with the body in exactly the same posture. The shooter must acquire his skill, therefore, not merely *as a skill* but as a muscular pattern superimposed upon rapidly changing bodily postures. Skills of this type are not uncommon in everyday life; but early experiments in the field indicate that special conditions of learning must be controlled if they are to be acquired rapidly and surely.[1]

Conclusion.—We have come, at length, to the end of this section upon Psychotechnology. In it we have sought to show, first, the sort of mental fact upon which psychotechnology is founded, and, secondly, the kind of problems and some of the results which fall to such a review. The space has prohibited a full account of all the practical advantages that have accrued from psychology; but a sufficient number of illustrations has been given to show the relation of the science to the world of human endeavor. If we summarize, without limiting ourselves to our own survey, the usefulness of psychological research, we find an impressive list of achievement to which psychotechnology can point. "The diagnosis, classification, and treatment of mental diseases, both in private and in our state institutions, rest upon psychological research. Such research has led to rational reforms in education. For example, it has furnished a sound basis for the estimation of ability in children and for a separate and appropriate education of the defective child. Again, it is responsible for an experimental study of school subjects and of the best ways of teaching them. During the war psychologists were able, through their methods of research, to estimate the ability and the special aptitude of every individual in the enlisted personnel of the Army. They solved, moreover, a large number of special problems of war referred to them by the government. For example, they were in a better position than others to select and to train aviators, gunners, and scouts. Psychological research has made a large contribution to the government's rehabilitation of disabled soldiers. It has, within the past few years, revolutionized the study of stuttering and of other defects of speech, and it has devised methods of cure which have returned to normal life many persons previously incapacitated. Psychologists are commonly retained by commercial and industrial concerns for the solution of specific industrial problems. The General Electric Company has, for example, maintained, for a number of years, a laboratory of psychological research for the study of psychological problems concerned with illuminants. Present practice in advertising display, advanced methods of salesmanship, and reforms in the methods of selecting men, have been determined, in a large measure, by psychological research. Upon psychology rests, in part, the training of thousands of 'social workers' whose task it is to solve mental problems raised by the delinquent, the defective, the vicious, and other disturbed members of the state. Psychological research has done more than any other agency for the standardization of methods for this huge task of the state. Ethnic and racial psychology is the key to many international puzzles. The present task of Americanization is, at bottom, a psychological problem. All public opinion, all national loyalty, all business confidence, and all general endeavor, rest upon emotion, will, and belief; and these are matters to be understood only by psychological research. The general public is as helpless today before the claims of unsound and pernicious beliefs and doctrines as it was a generation ago before the claims of the patent medicine and the nostrum. A 'mental cure,' a new religion, a novel form of 'spiritualism,' is widely accepted without critical inquiry. It is safe to say that no present function of psychology is more important than the steadying and corrective influence which it can exert upon the mental health and the sanity of the public." [1]

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[1] See Griffith, C. R., *Psychology of Coaching*, 1926; *Psychology and Athletics*, 1928.

[1] From an unpublished committee report.

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